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NATIONAL ESTUARINE POLLUTION STUDY. PROCEEDINGS OF THE GEORGIA PUBLIC MEETING HELD AT JEKYLL ISLAND, GEORGIA ON FEBRUARY 29, 1968

Federal Water Pollution Control
Administration
Atlanta, Georgia

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PROCEEDINGS

of the

GEORGIA PUBLIC MEETING

- - -

NATIONAL ESTUARINE POLLUTION STUDY

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

February 29, 1968

Aquarama

Jekyll Island, Georgia

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PUBLIC MEETING
NATIONAL ESTUARINE POLLUTION STUDY
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

Aquarama Jekyll Island, Georgia
February 29, 1968

- - -

The public meeting directed toward obtaining contributions from Georgia interests regarding the National Estuarine Pollution Study, being conducted by the Federal Water Pollution Control Administration, convened in the Aquarama, Jekyll Island, Georgia, Thursday morning, February 29, 1968, and was called to order at 9:00 o'clock a.m. by Regional Director John R. Thoman, Southeast Region, Federal Water Pollution Control Administration.

MR. JOHN R. THOMAN: Ladies and gentlemen, will you all please rise for just a moment.

Oh, Lord, Who dost bless them who bless Thee and dost sanctify them who trust in Thee, save Thy people and bless Thine inheritance. Give peace to Thy world, to Thy churches, to our government, to our armed forces, and to all of Thy people.

For every good and every perfect gift is from above and comes down from Thee, oh Father of Lights. And to Thee do we render glory, thanksgiving and worship now, and always, and forever and ever. Amen.

I am John R. Thoman, Southeast Regional Director, of the Federal Water Pollution Control Administration in the Department of the Interior. I want to welcome you to the second public meeting in the country held to gather information for the National Estuarine Pollution Study.

The first meeting was held in Mississippi last month, and the next one is scheduled in Florida in March.

Most of you already know the specific purpose and reasons for this meeting. Some of you who may not, let me summarize it briefly.

The National Estuarine Pollution Study was called for in the Clean Water Restoration Act of 1966. In that Act, Congress directed the Department of the Interior to make an extensive study of pollution problems in estuaries and to report to the Congress recommendations for future management programs.

This study is to be completed and submitted by November of 1969. And we in the Southeast Region are the first to conduct public meetings for the National Estuarine Pollution Study to obtain the views and opinions of local, public and private groups and individuals who have an interest in the use of Georgia's estuarine and coastal waters.

We will not be hearing today from sister federal agencies and state agencies. These two groups will submit their statements later. We are interested today mainly in obtaining public views and opinions.

Most of you were invited to appear here and make statements. However, anyone desiring to make a statement should let our people at the registration desk know, if you have not, and we will put you on the program as quickly as possible.

Today we have Ralph S. Howard, who you all know is executive secretary of the Georgia State Water Control Board, named by Governor Lester Maddox to represent the state's interest at this conference.

Mr. Howard is a member of our panel today and will be hearing today's statements and perhaps asking questions to clarify any of the statements that are made.

The other members of the panel, which includes myself, are Mr. Paul Traina, who is Director of Technical Services at the Southeast Water Laboratory in Athens, Georgia.

He is a native of New York, but he has spent most of his professional career in the South and Southwest.

Then next to Mr. Traina we have Mr. Howard Zeller, who is Water Quality Standards Coordinator and the former Deputy Director of the Georgia State Game and Fish Commission.

And next we have Mr. Eugene Jensen, who is the Director of the National Estuarine Pollution Study. He is a former commissioned officer of the United States Public Health Service, and for the last 15 years of which he directed the Shellfish Program of the Public Health Service.

And next to Mr. Jensen is Dr. Fred Singer, who is the Deputy Assistant Secretary of the Department of the Interior for water pollution control matters, and we are most pleased that Dr. Singer is with us today.

One thing we would like to make clear is that this meeting is yours and not ours. We are here to listen and learn. What you have to say is important to us. It will become a part of the record to the Congress.

It will contribute to the development of the national policy for estuarine management. The meeting record today will be held open for 15 days to receive any additional statements that any of you or anyone else may wish to make.

Mr. Tom Crites will be making a verbatim account of our meeting today, and if there are any comments from the floor, please identify yourself so it may appear in the record.

With that brief introduction, I would like to call on our first speaker, Mr. J. E. Hulse, Jr., the City Manager of Brunswick.

Excuse me, Rock, do you have anything to add at this point in time?

MR. RALPH S. HOWARD: No, I'm going to listen. I'm going to submit a statement from the State of Georgia, which will be prepared by the State Water Control Board.

MR. THOMAN: I would like to introduce now Mr. J. E. Hulse, Jr., representing the Mayor of Brunswick, and also representing Senator Talmadge, who also was unable to be here today.

MR. J. E. HULSE, JR.: First, let me say on behalf of the Mayor, it certainly is a privilege to have this study being held in our area.

On behalf of Senator Talmadge -- well, it is somewhat of an unusual situation for a City Manager to be here representing our United States Senator in any capacity at any meeting.

I would like to request of this panel and of the hearing officer that a copy of this transcript be sent to Senator Talmadge, inasmuch as his interest is deep, his concern is great, and he regrets that he can't be here today.

Pressing matters in Washington prevent his coming to this very important meeting.

The city would like to make this statement on behalf of the improvement of water pollution, water control, the estuarine areas around our coastal region, and we have filed a report with the state, and we will rest on our report with the state and ask that the state submit in their brief to you our portion of our concern regarding this matter. Thank you.

MR. THOMAN: Thank you very much, Mr. Hulse. Dr. Singer.

DR. FRED SINGER: First of all, I would like to express my appreciation to all of you for being here. We consider this study, this National Estuarine Study, to be of great importance to the nation.

This is why we are taking this deep interest in it, and I am happy to see that this interest is being reciprocated by people throughout the states.

As was explained to you, the purpose of this study is to make recommendations to the Congress. These recommendations have to be based on the wishes and the opinions of the people who are concerned with the coastal zone, and that is a good fraction of the population of the United States.

The purpose of these public meetings, of course, is to elicit these wishes and opinions. These recommendations will then be translated into suitable legislation as necessary, and will, we hope, lead to a rational system for the management of the coastal zone, which will involve the local authorities, state authorities and the federal authorities as necessary.

I am here to listen, and I hope that I can ask a few questions after some of the statements, and I know that the reports we will receive here will be immensely valuable to us.

MR. THOMAN: Next I would like to call on Dr. William H. Tailer, Mayor of Darien, Georgia, and President of the Chamber of Commerce.

DR. WILLIAM TAILER: Mr. Thoman, members of the board, ladies and gentlemen: First of all, I want to welcome you all to the Green Isles of Georgia. I'm not saying "Golden" today, because it is a little damp, but without water, the island wouldn't be golden, and without rain water, we can't drink and can't live.

So water is important not only to our appearance and to our health, but also to our economy. And while many of my comments today will be of a professional nature, it will be so mainly to preface what I think is important for the press and general public to consider, and that is, the importance of clean water.

We have some excellent and talented technicians who are going to give you facts and figures later, but my comments now will be mainly promotional.

Pollution, as you know, is becoming a major problem. Cleaning it up is a must. If we wait much longer, it may be too late. For years, our city, as others, has been dumping raw sewage in rivers.

Each of these private lines has been found to serve several buildings, and they were known as private sewer lines. Now, this sort of thing occurs in several cities, but it started about eight years ago, and it's high time this sort of nonsense stopped.

Dumping raw sewage in any stream or river is ridiculous. For a number of years, our city, as others, has had ordinances prohibiting many things, but we have failed, as other cities have, to enforce them.

I am faced with the problem -- "Wait a couple of years now until we can get a federal grant to help us get a sewer system in the city."

But not too many years ago, Brunswick had the same problem. Those inlets on Blythe Island were literally full of bacteria, and if one were to get a nick or a cut, the skin would get infected.

Estuary pollution is a difficult problem compared to the straight salt or fresh-water problem, but this also must be stopped by cities. Fishing, swimming, oyster production and harvesting on our local coast are presently endangered by sewage pollution.

As chairman of our County Board of Health, I must insist that oyster harvesting above or downstream from us continue to be restricted. It has been restricted.

There is a lot of argument about it. Some say the waters aren't polluted, but unfortunately, when raw sewage is dumped into a river and ten miles below you there's an oyster bed, I don't thank those oysters are going to be as healthful as you would like to eat.

I do like oysters. I hope you do too. On this coast, in the last ten to 12 years, we have had dozens of cases of hepatitis, some of which have been traced directly to oyster eating.

The oysters came from a polluted bed. This is a shame. If our joint entity and purpose is the same throughout our country, and if the United States Pollution Control Administration can help us, we all deserve to work together as citizens, as leaders of civic government, as leaders of civic bodies.

If you have industries in your area which are dumping chemical waste, oil, et cetera, in the water, you must stop it. You can do so by getting an injunction. Don't be afraid.

Get some backing and get it stopped. If you don't make a noise, no one is going to listen to you, and the louder the noise you make, the quicker they are going to do something about it.

Get your County Health Department and your State Health Department to help you. Make a fuss about it. Little towns have done it; big towns have done it; so you do it. You can do it.

And we must make our own local efforts to benefit from the increasing technological advances that both state and federal governments have made available to us.

Why should we do this? Simply because if you don't let them know you want help, they aren't going to help you. I don't think we should wait for our rich uncle forever to get us going.

What sort of city is yours? Is it the sort of place that you like to live in or that you would want your friends to come and live in? Is it a place you're proud to raise your family in?

Is it a town you would be happy to live in the rest of your life? Is it the type of place you would like to retire? Is it the type of place you would like to pursue recreational interests in?

If it isn't, why not? Work toward it, gentlemen. Thank you.

MR. THOMAN: Dr. Tailer, would you wait just a minute. There may be members of the panel who would like to ask you questions.

MR. HOWARD: I would like to commend Dr. Tailer, because I know they have some real problems, and one of the biggest problems is to get the sewage system.

MR. EUGENE T. JENSEN: I would like to ask Dr. Tailer two questions. One, does your county, or does your city, have some sort of a community planning organization?

The basis for my question is, how does one make public choices between areas which are now used or which should be used for recreation or areas which, perhaps, should be set aside for industrial development?

DR. TAILER: Until recently, nothing had been done, but last year a city planning board was formed in the City of Darien, and very recently, the County Commission passed a resolution to have a joint planning board for city and county planning, and this joint planning board should be able to harvest all the technological planning help that is available so that we can keep track and prevent scattering of various types of use of land, whether it's industry, recreation, et cetera.

This planning board has recently been started off. It isn't finished, but we are on the way.

MR. JENSEN: How would this joint planning board -- how do you think it might take into account these various uses of the estuary? Would it be concerned equally with the water part of your environment and the land part?

DR. TAILER: Very definitely. The use of water, as you know, is not only for commercial purposes, but recreational, and the recreational aspect is not just boating, but it includes getting in the water, so we have got to get in the water.

MR. HOWARD: And we can't do anything about the river up above us. We can fuss about it, but we have got to clean it.

MR. JENSEN: The point I believe he was making, Mr. Howard, was the relationship between classification, estuary and water classification. It's to ask, really, if the committee was giving any thought to this.

MR. HOWARD: We are going to consider many of these things that you brought up, but we haven't had the chance to do so yet.

MR. THOMAN: Thank you. Next I would like to call Mr. James Morrison, President of the Georgia Natural Resources Council. Is Mr. Morrison present?

He indicated that he wanted to make a statement. Well, maybe he will be here later.

And now it is my very distinct pleasure to introduce to you Dr. Eugene P. Odum, distinguished alumnus of the University of Georgia, Director of the Institute of Ecology of the University of Georgia, and the author of a very widely used textbook in ecology.

Gene, are you going to represent all of the university's statements?

DR. EUGENE P. ODUM: No, I'm going to present a general statement, and then there are several others in our university who would like to make statements.

The University of Georgia is contributing to the study and development of the estuaries and sea islands which are among the state's most unique, widely hearalded and valuable natural resources.

Agriculture, Forest Resources, Landscape Architecture, Biological Sciences, Geology, Geography, Community and Area Planning, and the Marine Institute at Sapelo are but a few of the university schools and departments which have an interest in and knowledge about various aspects of the tidewater region.

Individuals from a number of departments have prepared statements in areas of their special competence for inclusion in these hearings.

It is my task to present a picture of the estuarine region as a whole, which, hopefully, will help in formulating logical plans of development that will avoid senseless pollution and deterioration of human living space such as is even now beginning to bring economic ruin to some parts of the Atlantic coast.

In other words, the university, such as the University of Georgia, is to serve the state, and it is made up of multidisciplinary groups, each of which has interests and viewpoints, and we all stand as university scientists ready to serve.

We, as individual citizens, should be equally interested in avoiding the destruction of natural resources. All citizens should, as you have just heard, want to do everything they can and be vigorous in preventing the destruction of these resources.

Now, the title of this statement is "The Theory of the Estuarine Ecosystem in Relation to Use, Management and Pollution."

In other words, this will be just a little discourse in ecology of the very general broad picture of our environment. Now, in ecology, we use the term, which you may have heard or not, called "ecological system" or "ecosystem."

We mean by this any area of the landscape in which sun-energy plants, animals, man, water, minerals, et cetera, interact so as to sustain life on a continuing basis.

We find this term useful in the abstract, for example, in speaking of the interdependence of man and his environment in the very concrete case -- for instance, we might talk about a pond as an ecosystem.

What that means is that we are studying the pond function as a whole, like the doctor would look at you as an individual to see if you're well or sick.

This kind of approach of studying a piece of nature as a whole is a kind of new science, and this is one which we at the University of Georgia are very interested in pushing.

The estuarine region can be considered to include sounds, creeks, river mouths, marshes and all those areas where sea and fresh water mix. The estuary is a well-defined ecosystem because of the many environmental features that separate it from adjacent upland and open-sea environments.

Since all things are interdependent in an ecosystem, it follows that we must eventually subject both knowledge and human needs to some kind of systems analysis, which is a technical phrase for an "evaluation-of-the-whole" procedure, if we are to select the wisest uses and avoid conflicting manipulations.

In other words, we can all see that ultimately we are going to have to make the decisions and going to have to decide between various uses and so on, and to do this properly, we will have to do what the engineer often does, and in his limited viewpoint, determine which of these procedures is best for the estuary as a whole or for the problem as a whole.

Now, we are not too far along in knowing how to do this in terms of large natural areas. We are just trying to learn, and we think that this will be the big approach in the not-too-near future.

Now, the next point I will make is that coastal estuaries and the adjacent alluvial plains, such as occupy a wide zone along the Georgia coast, are among the most naturally fertile landscapes in the world.

The fertility of estuaries is often greater than that of the land on the one hand or the open sea on the other. For example, the rate of net primary production of the shallow waters and marshes lying between the mainland and the sea islands of Georgia, as measured in a series of studies at the University of Georgia Marine Institute, is estimated to be better than ten tons of organic matter per acre per year.

Now, this kind of a production, this kind of natural productivity, is double or triple the best agricultural crop production that we have in this state.

By net primary production, we mean the amount of organic matter produced by green plants which is not used by the plants themselves, and which is thereby potential food for heterotrophic organisms -- animals, microorganisms and man.

The potential for production of seafood for man in Georgia estuaries is thus very great, far greater than is now realized. I don't think this is generally realized that we could grow tremendously more oysters and things of this sort, based on the fact that there is this fertility present.

Estimates in terms of pounds and dollars are presented in the testimony prepared by Dr. Linton of the staff of the University of Georgia Marine Institute.

Yet, seafood is only one of a whole spectrum of values that affect not only the people of the coastal counties, but inlanders as well, who come to enjoy the beaches and the beautiful watery vistas of open spaces immortalized by Sidney Lanier's poem, "The Marshes of Glynn."

Like any valuable natural resource, estuaries deserve to be studied, their values understood and their usefulness protected against pollution.

Now, the second point I want to make is that estuaries belong to a class of ecological systems which can be conveniently designated as fluctuating water-level ecosystems.

The ebb and flow of water is one of the mechanisms that contributes to fertility, because such back-and-forth circulation constantly concentrates and distributes the vital gases, such as oxygen and carbon dioxide, and minerals, such as nitrates and phosphates, on which productivity depends.

An estuary acts essentially as "nutrient trap," in that nutrients are held and concentrated in the estuarine zone. For example, let's take an example from data obtained by Dr. L. R. Pomeroy of our university.

He found, for instance, that phosphorous in river waters entering our estuaries is very low in Georgia. We talk about phosphorous here in terms of micrograms per liter, but in the estuary itself, the concentration increases 50-fold.

It goes from 0.1 micrograms per liter to five micrograms per liter. It goes to the point where plant production is no longer limited by the supply of this vital fertilizer.

You see, the estuary tends to trap and hold and concentrate valuable nutrients. You can see what I'm driving at is that we don't want, if we can help it, to destroy the circulating mechanisms which are already there.

Abundant nutrients and sunlight in the warm waters of Georgia estuaries are converted into three types of plant crops: (1) microscopic floating plants in the water itself, (2) microscopic plants growing on surfaces or sediments in shallow water throughout the intertidal zone, and (3) we have the marsh and sea grasses which are particularly characteristic of this part of the coast.

Now, all these crops grow the year around, so they are out there working all the time. They don't have to be planted and fertilized, but they are always operating.

We should emphasize that all three crops contribute to the total productivity, and damage or loss to any one of these would reduce the total productivity of the system.

Now, to the casual observer, the salt marshes that are such a conspicuous part of Georgia estuaries would seem to have no direct relationship to the shrimp and fish being harvested in the sounds and offshore.

Yet our work at Sapelo indicates that there is, indeed, a strong connection between marsh grass growing up out of the water and shrimp, say, growing in the water.

The way it works is that marsh grass is harvested by tides and converted by microorganisms into finely divided particles called "detritus," which becomes an important link along with microscopic plants in the food chains of the estuary.

There is no longer any doubt that the marshes are important nursery grounds for almost all species of commercial shrimp and fish; the young stages of these species congregate and undergo their most rapid growth in the marshes and upper tidal creeks where productivity of plants and microorganisms is greatest.

For example, it is well known that commercial shrimp spawn offshore and the young larval stages move into the small creeks and marshes where most of their growth takes place.

On reaching adult size, they then move out through the sounds and offshore water where they are harvested. If the salt marshes and the network of tidal creeks are filled in, dredged or destroyed, or if they are made inaccessible to incoming larval stages by downstream pollution, then there is no question that a substantial portion of larval food needed would be cut off drastically, reducing the seafood potential of the entire coastal zone.

Physical destruction or poisoning by pollution of the inshore nursery grounds would, in our opinion, completely destroy the multimillion-dollar shrimp industry.

Now, one other point I want to make is that in many basic ways, estuaries operate naturally in the same manner as man's rice culture system where alternate flooding and drawdown contribute greatly to continuous fertility.

The high production of oriental fish ponds is also enhanced by periodic fallowing of the ponds. Thus, the estuary is a natural system which operates in the same general manner as some of the most successful of man-made agricultural systems, yet it has the advantage that tidal energy, rather than human labor or tax dollars, does the work of circulation and fertilization.

Theoretically, then, man has only to reap the harvest. Unfortunately, because of a lack of understanding of the complex nature of the estuarine system with its interdependent parts -- water, sediments, marsh grass, critical tidal-flow rates, nutrient traps, seafood nursery ground, et cetera -- and because the high natural fertility is not generally appreciated, estuaries of the Atlantic coast are in grave danger of being destroyed before their potential usefulness can be exploited.

Now the next point I want to bring up is this: Estuaries are especially vulnerable to pollution and to dredging that interfere with water circulation.

Because the organic load and rate of productivity is high, the oxygen demand of the system is great. This demand is normally satisfied by the combined action of strong water circulation and the activities of green plants.

Many parts of an estuarine system are normally operating at full capacity in regard to oxygen. There isn't much leeway here. Since most types of pollution, both domestic and industrial, have a high oxygen demand, a relatively small added input can cause the system to go anaerobic, which means that it becomes, biologically speaking, useless.

Like a race horse running at its limit of speed, any added load can only reduce its performance. There are already local examples of this on the Atlantic and Gulf coasts.

For example, Hillsborough Bay in Tampa Bay has become so polluted and anaerobic that noxious odors and restricted water uses plague the City of Tampa.

In this case, the lack of secondary sewage treatment plus waters from phosphate mining contribute to the deplorable situation.

Pesticide pollution, a growing problem everywhere, can be especially critical in an estuary, since the nutrient trap mechanism not only traps and concentrates useful minerals, but also poisons, especially the persistent materials such as DDT.

Concentration of such pesticides tends to build up in the organic detritus and the plant-animal food chain by a process that has come to be known as "biological magnification."

Furthermore, eggs and larva of seafood organisms are especially sensitive. Studies on Long Island recently published in the journals of "Science" and "Scientific American" have shown that sediment build-up and ecological magnification have resulted in very high and alarming DDT concentrations in tissues of fish and sea birds.

A group of citizens has recently initiated legal proceedings to get their own municipal governments to stop broadscale use of DDT. The suggested solution is to use less persistent insecticides, that is, ones which degrade in water and do not build up in concentration, in mosquito and other insect control.

An inexcusable type of pollution is the release of untreated wastes by pesticide manufacturers. Several spectacular fish kills have recently been traced to either careless or accidental release of wastes which contain large amounts of the most toxic insecticides.

While the pesticide industry perhaps has a special responsibility to the public, in that they are dealing with potentially dangerous poisons in high concentration, we would not single them out as being different from other industry, since, as already indicated, all industry bears a responsibility to man's environment.

Quality engineering in waste treatment, as well as in the product, must become a part of the American creed of finding better ways to do things.

The purpose of our testimony here is not to point fingers at anyone or to dwell on past mistakes, but rather to emphasize that the estuarine ecosystem is a complex, productive and fragile landscape which is especially vulnerable to pollution.

In conclusion, secondary, that is, complete, treatment for both sewage and industrial wastes is the goal that must be reached as soon as possible.

Cities and industry should share equal responsibility because the economic price of pollution in terms of lost uses and expensive clean-up is almost certain to be higher than the cost of prevention.

Furthermore, there is growing evidence that once an estuary has been thoroughly poisoned, it can never be fully repaired.

The documented case of the Delaware Bay is an example. Georgia is fortunate in that there is time to plan for the type of secondary waste treatment that will maintain water quality.

Coastal cities and industries, because they are surrounded by so much water, are lulled into false security in thinking they don't need secondary treatment of wastes.

This is definitely not so, because water is shallow and not always moving in an outward direction.

Now, I have one other point. The natural high fertility and usefulness of estuaries dictates that use and management should be based, as far as possible, on the concept of utilization of existing resources without changing the biological productivity and the basic flow pattern of the system.

The challenge is to learn how to use and maintain the high fertility, rather than to change the system radically, which can only reduce its usefulness.

This, of course, is in contrast to many land areas where productivity and usefulness can often be increased by replacing natural plants with cultivated crops, or by manipulation of physical factors, such as irrigating a desert.

Since the estuary is already a naturally irrigated system with adapted organisms, it is folly to destroy without reason or by neglect or poor planning this naturally engineered irrigated system just as it would be folly to destroy willfully an expensive irrigation system set up with our tax dollars.

If an acre of prime Iowa farm land, which produces meat by means of a corn-hog food chain is worth $400 an acre, then an acre of Georgia estuary is of at least equal value, because it can produce dollar-value-equivalent meat through a marsh-grass-detritus-seafood food chain.

Add to this, recreation and open space values, which are certainly superior to that of a corn field, and the value increases. The capacity of estuaries to act as air and water purifiers for wastes is a long-term value which is difficult to calculate on a short-term basis.

The value is very great, however, when one considers the tax dollars required to correct pollution when it is allowed to get out of hand, as in the Hillsborough Bay example already mentioned.

We can conclude that estuarine real estate is worth on the average of at least $500 per acre and is thus too valuable (1) to fill in for conventional agriculture, industrial sites or other uses for which less valuable dry land is available, and (2) to use as open sewers for untreated wastes.

In Georgia, a pattern of use zones, which we think provides an excellent basis for future planning, has already developed. Essentially, there are three broad use regions.

We have the industrial zones, as for example, the Savannah River estuary, which are subjected to extensive modification and where pollution control and maintenance of water quality are of paramount concern.

In other words, the concern here is keeping control of the pollution situation.

Then we have another zone type. Other large areas of our coast are in what I would call natural-use zones, where the basic pattern of landscape remains undisturbed and where recreation, fishing, seafood production, et cetera, are the primary purposes.

To maintain such use, it is necessary that large areas of shallow water and marsh be acquired by local, state, federal agencies, or by private foundations so that restrictions in the public interest can be effective.

It should be emphasized that "natural-use planning," in this case, is intended to provide full utilization in its natural state and is, in no way, intended to restrict human use of economic return, so long as such uses do not destroy the natural beauty and reduce productivity as it already exists.

Within a large natural-use area, a gradient of use intensity is desirable, ranging from wilderness areas to heavy-use seashore parks. We believe that large sections of Georgia coast should remain in the natural-use category.

And then there are the research zones. The Sapelo-Blackbeard island region comprises a unique research area maintained by foundation and federal support.

It is particularly important that large areas of typical estuary be available for, and restricted to, research use. Not only are there many basic studies that must be done, but also feasibility studies on oyster farming, effects of waste material, and the like, can only be carried out on a reasonable large scale.

We would recommend for the whole Atlantic and Gulf coast, that estuarine research parks be established or developed from expansion of existing marine laboratories, at intervals of 100 to 200 miles.

This could be built around an existing laboratory or a new laboratory in which we keep on top of the study experimentation of this very productive, relatively unknown part of our landscape and one which we have already pointed out is being greatly threatened by such things as pollution.

I thank you very much for the opportunity to come and speak to you.

MR. THOMAN: Would you mind answering a few questions?

DR. ODUM: I would be happy to.

MR. THOMAN: I'm sure the panel has some.

MR. HOWARD: I'm glad to have heard your presentation, and I want to congratulate the university for what they have done over on Sapelo Island. As you know, we have a cooperative study going on, and I think we are going to get some answers there.

DR. SINGER: I was particularly interested in your concept of the research area and research labs. How do you visualize this being done, and what role would you like to see the federal government play in this?

DR. ODUM: I think the federal government would have to play a considerable part here, because the funds for doing this kind of research -- well, they are made available by the state, but much more of the work that the University of Georgia has been able to do has been the result of getting federal grants.

So I think that the point is that the acquisition of research areas -- I think the federal government is interested in this, as any source of help here is, and certainly, the federal government would have to be involved in this, since this is interstate.

I guess now that some of our work has even been taken to court in order to prevent the destruction of valuable marshes in Massachusetts, so you see, whatever information we gather, wherever it is, will immediately be available. This is open information.

DR. SINGER: Would you perhaps list some of the practical benefits of some of the research that could be done in these estuarine research parks and laboratories?

DR. ODUM: Well, I mentioned the oyster research, which we are carrying on now with the help of Japanese consultants, the use of raft culture or long-line culture.

Things of this sort are very promising, I think. They show that we could double or triple -- well, Dr. Linton will testify in detail about this, so I think I will wait and let him answer in detail about this.

That's one thing. The other thing is the study that is most exciting to us, learning how the detritus food chain works. These little particles that people don't think so much about are really highly active microorganisms.

We don't know much about the microbiology of this system. All we know is about the pathogenic bacteria, but we don't know about all the useful bacteria, which is, I think, important, and I think this is one of the big contributions.

And again, I think we need to use isotope tracers or radioactive tracers in order to follow where this material goes, and here we have to have an area that is under control to do this work.

We have to be able to follow what happens to phosphorous if it has a radioactive tag. We have done this on a 20-acre marsh as a small experiment, but we need to do this sort of thing on a large scale.

So our research park idea is based on the fact that the laboratory must be outdoors. You have the indoor laboratory, yet, but that's not the main part.

It must be a controlled laboratory outdoors. These studies must be made as a whole. You can't get these answers by pieces, by looking at this piece here and that piece there, and this has been the trouble, the fish program here, the shrimp program here and so forth, and they are not integrated, and we must have areas where we can look at the whole ecosystem concept.

In my opinion, this can only be done in a research park.

MR. TRAINA: You mentioned two characteristics of estuaries. One is this strong circulation pattern which allows the materials to come and go and waste products to be removed.

The other was the nutrient trap characteristic. If we upset either of these processes, either by release of the materials, or dredging or changes in the circulation pattern, how reversible is this process?

DR. ODUM: To a point, it's reversible, but, as you know, in the big National Academy of Science bulletin that came out recently, called "Water Pollution Control" -- I think it is a Spilhaus Report.

MR. THOMAN: It is "Water Control and Management."

DR. ODUM: Thank you. They made a special study of the Delaware Bay, which is one of the worst polluted estuaries, and their conclusion was that theirs is already irreversible, that even if you cleaned up the pollution, it's too late. The system is permanently damaged.

Sediments would be coming out for centuries. In other words, this estuary has stored all of the problems of man that they didn't want, all of the things they wanted to get rid of quick, and once they are stored in there, they are there.

They don't come out easily.

I would say it's reversible up to a point, but there comes a point we all fear when you have gone too far. Of course, this is true of life in general.

It's easy to kill things, but then when they are dead, you don't revive them.

DR. JENSEN: Doctor, I would like to hear a little bit more of your ideas about the size or structure of one of these estuary experiment stations.

DR. ODUM: Well, this could be based on essentially a watershed idea. For instance, if you have a river coming in, then there would be a certain area, fairly natural area, that would be influenced by this and that would have bodies of water, and marshes and so on integrated in it.

The idea is that these should be large enough to contain at least a complete drainage basin. In other words, so that all the water movement is within the area, and at Sapelo, for example, in our research station there, we think that the minimum area to do these kinds of studies might be ten square miles or something like that, but this would vary with the type of data and so on, but it should be equivalent to a large watershed or a large area where we control for research the entire pattern of input-output.

This is quite a bit larger than most people realize. They think a laboratory is all you need beside the sea, but this is not the case. In industry, for instance, you would never go from a laboratory to full production.

You always go through the pilot plant. Everybody knows that. You wouldn't dare go from the laboratory -- well, it's the same thing with us in research. How can you expect us to go from our little studies to recommending something for the entire estuary without having a pilot plant built to study this?

This is the concept none of us can project from laboratory or small-pond studies of that sort or shrimp raising or that -- you can't project to the larger area. Things change.

I would say that we need to have a larger area, but we have one of the largest areas on the East Coast, and we feel very fortunate.

MR. JENSEN: Then for each of these stations, you would also like to see engineering, the marine biology, perhaps -- all of these disciplines, all of these groups -- brought together?

DR. ODUM: Right.

MR. JENSEN: Estuary hydrodynamics?

DR. ODUM: Right. You will find, in the testimony by Dr. Henry, our Director, that many of these things you just mentioned are actually now going on. We need more support, of course, and money.

The point is -- the idea is, I think, very broad and good ideas should eventually bring us results.

MR. THOMAN: Dr. Singer.

DR. SINGER: I have one more question. You put your finger on an important point of conflict. Do you have, in the matter of pesticides -- you have on the one hand the farmer who would like to have a pesticide which would last forever, who wants to apply it once and would like to have it last forever.

He doesn't want it to degrade.

DR. ODUM: That's right.

DR. SINGER: And on the other hand, you have pointed out the interest in people who deal with estuarine ecology who would like to have none of it come into the water, or if it does come into the water, they would like to have it be degrading as rapidly as possible.

Do you see any technical possibilities or scientific possibilities for the future, and do you have any recommendations you would like to make on this matter?

Do you particularly see any role for the federal government?

DR. ODUM: Yes. Again, value judgment should be made on the ecosystem base. For instance, if the area that you are treating, say, is a large upland forest area where there are no water courses to amount to, then you may be able to use the more persistent, because you know where it will be.

It will stay there, and it won't go down to hurt somebody else. The trouble in the estuary region is there is so much water circulation and movement going on, and you think it's going out to sea, and it doesn't. It comes back or stays there.

My point is, don't play around with these things that last forever, because the trouble is that most of them that you put on the land -- of course, these people who dump the things out of industry are dumping enough concentrated stuff just to get rid of it, and in this case, you have got it for a long time.

Even though it doesn't kill the fish, it's there and hurting the whole system. This ought to be avoided, and this is what we call a senseless-type thing, because these things can be prevented now.

This is not an area in my competence, but I'm just pointing out that the broad principles, I think, are apparently clear. It depends on the leakage of your system, let's put it that way, if your system leaks, then let's do not use these things that last forever, even if it's more trouble to use the others, such as mosquito control.

DR. SINGER: Do you find that your local government and your state government are well aware of these problems?

DR. ODUM: We are trying to make them aware of them.

MR. THOMAN: Thank you very much. Next I would like to call on Mr. Dean Wohlgemuth, Convention Chairman of the Outdoor Writers Association of America.

MR. DEAN WOHLGEMUTH: First I would like to tell you just a little bit about what Outdoor Writers Association is, because I believe probably most of you may never have heard of it.

As its name implies, it is an organization of outdoor journalists. We represent all types of news media in the outdoors recreational field, such as hunting and fishing.

We have 1200 active writers, television and newspaper men in our organization. We deal in everything from small newspapers up through national magazines.

We feel that we are the voice of the outdoorsmen, and in a sense, we are the conscience of the outdoorsmen. We have a finger on the pulse of the outdoorsmen, and certainly, in matters of water pollution, the outdoorsman is usually one of the very first to detect a problem in the outdoor environment, such as water pollution.

Certainly they report to us very promptly if they see something they don't like. And we feel it is our responsibility to report to the public, then, these problems, and to try to seek a solution to find ways to cure these problems.

There was a time when an outdoor writer perhaps was a man who had a fishing rod or a gun in one hand, a camera strapped around his neck, and a typewriter in the other hand, and he would go out in the field or to a lake or stream and then come home and write how he and Jim went fishing.

It was all in good fun. Today we realize that if we are to have hunting and fishing in the future, that something must be done and must be done today to protect our outdoor resources.

And certainly, we can't have much fishing if we have nothing but water pollution everywhere. We realize there must be a reversal in the trend toward water pollution, so we want very sincerely to support, in any way we can, efforts to produce more clean water.

Of course, this all sounds like it's good fun, but I would like to point out that outdoor recreation is an important business. It has a great deal of impact on our economy, locally, statewide and nationwide.

A man goes hunting or fishing, and he spends a good deal of money, not just on tackle and bait, but he has to have a place to live while he is out, he has to have food, he has to have clothing, he buys gasoline, he spends a great deal of money which goes into your pockets.

Everyone gets a little piece of the money that he spends while he is out. So we do have an impact, outdoorsmen as a whole, on our economy in various regions, so it is important to all of us that we do continue to have good facilities for these outdoorsmen.

And naturally, whether it is strictly a matter of economics or not, we feel like to be happy and healthy people, we must have satisfactory outdoor recreation.

Certainly, I think, many industries have discovered that when they go about finding a place to locate a new plant, one of the first things they ask for is, "What do you have in the way of recreation for our employees when they are off duty?"

And they are most interested in hunting and fishing. Of course, industries are directly related in many instances toward water pollution. We do feel like we should report that something should be done, and perhaps I can't speak for the entire organization, but we feel like -- I feel like -- that whoever uses the water should be responsible in some degree in making sure that it is kept clean.

But again, as I say, it's not up to us to dictate how this should be done. This should be left to the scientists. We feel that it is our job, of course, to report progress in this field and to see that the public is informed in what is being done. Thank you very much.

MR. THOMAN: Thank you very much. Does anyone have any questions?

MR. ZELLER: I have heard it said that the sports fisherman's potential on the Georgia coast is perhaps one of the most underrated anywhere in the country. I wonder if you would comment on that a little bit, and if such is the case, why do you think the sports fishing here on the Georgia coast is underrated?

Is it because you writers are not writing about it, or facilities are not here; what are your thoughts on this?

MR. WOHLGEMUTH: Mr. Zeller, I think that is sort of a chicken-and-egg prospect. Which comes first, the chicken or the egg? In this case, which comes first, the business or the advertiser?

I think that I should have said advertising promotion. I think that would have been a better way to say it. Certainly, the potential is here, but no potential can be fully utilized until the public is made aware of it.

Of course, this comes back to the outdoor writers. We should let the public know about it, but then someone has to let the outdoor writer know here is something to write about, too, and businesses must be willing to attract new business.

And it is important in this regard, that a business does a little bit of advertising in order to gain more business. Of course, he has to have enough business to afford to buy the advertiser, so this is where we get into the chicken and the egg situation.

I know this is not a place to put in a commercial of this type, but I would like to point out that the Outdoor Writers Association is coming to Georgia for its annual convention next June, and it will be getting a good close look of what Georgia has to offer, and I certainly hope to have a good number of these writers to come to the Georgia coast so that they might write about what we have to offer in this regard, and then the world will know a great deal more about what Georgia has to offer.

Their writings will appear, as I said before, in magazines of national impact and also other media right on down to the local weekly newspapers that may not have a circulation of more than just a few thousand, but we are represented in every state in the nation.

We have members in Canada, Mexico and also in the Bahamas. While we are 1200 strong, all of these people will not be in Georgia, but we expect to have about 250 writers from all sections of the nation, so we hope that we can tell the story of Georgia to the entire nation.

MR. HOWARD: Do you live around Brunswick?

MR. WOHLGEMUTH: No, sir. I'm from Atlanta.

MR. HOWARD: I wondered if you knew of any good fishing spots along the coast here. I know that Mr. Zeller does, but he doesn't write about them.

MR. WOHLGEMUTH: Well, my home is at the other end of the state. I don't get to this end of the state near as much as I would like to.

MR. HOWARD: For the record, we have some very fine fishing spots existing on the coast of Georgia -- commercial fishing and sports fishing. I would like everybody to know that. (Laughter)

MR. THOMAN: Thank you. Next I would like to call Mr. Glenn Kimble, who is chairman of the Air and Water Resources Committee of the Associated Industries of Georgia. Glenn.

MR. C. GLENN KIMBLE: My name is Glenn Kimble. I appear here in behalf of the Associated Industries of Georgia. My purpose is to reaffirm the position of this organization of Georgia business and industry with regard to the management and protection of the waters of Georgia.

As many of you are aware, the Associated Industries of Georgia has initiated many efforts and has actively supported the efforts of others to improve the protection of our air and water resources. It is our intent to continue to pursue this course.

Concerning the matter under discussion today, the estuarine waters of this region, we urge caution and the fullest consideration of all the components of this region's socioeconomy, both present and potential.

There is probably no single hydrographic system which equals either the complexity or the importance of the estuarine waters of the east coast of America.

It is clear that the present condition of these waters demands responsible attention. I emphasize the word responsible. We feel that no drastic steps should be taken without considering all of the effects.

By this, we do not mean to convey that nothing should be done. We believe that there should be efforts to improve existing conditions and to plan for the future.

However, we believe that something is being done, that great effort is being expended fruitfully.

Industries and municipalities alike are spending millions of dollars to construct treatment facilities for their wastes. There is research being done by the University of Georgia at Sapelo Island.

The state-sponsored Ocean Science Center being built at Skidaway Island promises to provide even more intensive research. Georgia has provided a sound and practical program which will protect the estuaries and the other waters of this state for the greatest good of the greatest number of Georgians.

Surely all of the job is not yet done; nor will it ever be complete. If Georgia and the nation continue to grow in numbers of people and in economy, and we believe that they will, there will be a continuing and intensifying need for research to find better ways for the control of pollution and for its prevention.

We recommend that the efforts of any new agencies or funds be directed to these ends. We strongly urge that the administration and enforcement of pollution control efforts in the estuarine waters of Georgia be left in the capable and competent hands of the Georgia Water Quality Control Board. Thank you.

MR. THOMAN: Thank you very much, Glenn. Let me ask you a question. You may not want to answer it. As a representative of Associated Industries of Georgia, what is your view on the concept that Dr. Odum put out about possibly zoning the coastline?

MR. KIMBLE: I think that the problem now is not to try to return all coastal waters to their original condition. I think we all admit that it is impossible, but to concentrate navigation, municipality, and industries in areas which we keep in as good condition as we possibly can and then reserve other situations for normal use, as Dr. Odum spoke of.

MR. THOMAN: If we assume this zoning thing is necessary, how should it be carried out? What is your recommendation as to how this can best be done?

MR. KIMBLE: Are you speaking of a total spectrum of uses?

MR. THOMAN: Yes. Suppose somebody adopted this zoning concept. Who should do the zoning?

MR. KIMBLE: Aren't we already approaching that with our regional planning commissions? Rock has zoned parts of the state already by --

MR. HOWARD: Actually, I do accomplish something by some of our standards and classifications. How precise it can be, I think, is a matter of opinion. But some of these studies we need to make now on some of the things that Dr. Odum brought up are just the reason why we are going to have this study.

MR. KIMBLE: At some point, we need to get a better relation established between out state, regional and local planning boards and our water uses. I think we have made a lot of progress on that already in the last five years, and I think we have a little farther to go, because we may find from time to time that these things have to be changed.

DR. SINGER: Mr. Kimble, zoning is actually the responsibility of local government and has always been very jealously guarded, but supposing a conflict should arise where the state would decide it's in the best interest of the people of the state to do some rezoning, because, hopefully, government is basically trying to attract industry to increase economic opportunities, how does one really solve such difficult problems within a state?

MR. KIMBLE: You're getting me a little out of my field.

MR. HOWARD: Go back to, you know, water pollution. That will tell you how to resolve that one.

MR. KIMBLE: Certainly, the zoning of water uses has been taken out of the local municipalities already. It is on a state basis already.

MR. JENSEN: I have one question. The amendment to our Act also says that we are, in making our recommendations to the Congress, to consider the respective responsibilities of public and private sectors of our economy.

I wonder what your thoughts would be on the desirability of some sort of a permanent national estuarine advisory committee on a national level which would provide a mechanism for industry and government at various levels to talk to each other on a more or less continuing basis on our estuarine problems.

MR. KIMBLE: Is this really much different from some of the national boards and committees that are already established for water-basin planning and establishment of criteria and so forth?

MR. HOWARD: There was a National Advisory Panel appointed by President Johnson in 1965 that had a great deal to say about estuarine studies and estuarine pollution.

What they ever did with that, I don't know. I think you could go back and use that and save a little money. There were people on that panel like John Dyer from Martin.

MR. KIMBLE: Certainly, industry is always willing to cooperate in any mechanism being set up to bring together the problems and thoughts of the different sectors.

MR. JENSEN: The estuaries have been left out when we have considered our natural resources in the past. We have always talked about rivers, oceans, forests, agricultural land and open space in our cities, but it's only within the last few years that government generally has caught on to the fact that the estuaries are something quite different and quite special.

Dr. Odum did an excellent job, I think, in describing them as a fragile resource.

MR. KIMBLE: I'm still not convinced that the mechanism for controlling the land use and water use in estuaries needs to be any different than it does for any other water or land.

The problems are basically the same, although you certainly have to use a different technique on the coast of Georgia, compared to the mountain streams or the Chattahoochee River.

They are all different, but they can all be handled about the same way.

MR. THOMAN: I would next like to call on Dr. W. D. Burbanck, Professor of Biology at Emory University.

DR. W. D. BURBANCK: "Estuaries are a happy land, rich in the nutrients of the continent itself, stirred by the forces of nature like the soup of a French chef; the home of myriad forms of life from bacteria and protozoans to grasses and mammals; the nursery, resting place and refuge of countless species whose urges cause them to migrate or to seek varying habitats for youth, maturity and old age." -- Dr. Stanley Cain, Assistant Secretary of the Interior for Fish and Wildlife and Parks, Woods Hole, Massachusetts, August, 1966.

We want to keep this happy land. During the past 20 years, I have worked as a biologist and ecologist in estuaries in 21 states of the United States, three provinces in Canada and six countries in Europe.

I am particularly interested in a small animal, less than an inch long, which characteristically lives buried about two inches in the soil below the water.

To observe the habitats of this animal and learn why it thrives in some estuaries and not in others, I have repeatedly revisited many of the places where it grows along the Atlantic coast and the Gulf of Mexico and have published numerous papers on the subject.

My remarks on pollution problems in estuaries are based on this experience. In nature, environmental changes may take place slowly and the plants and animals can adapt to the changes.

When I started studying small estuaries in Massachusetts in 1948, much of man's encroachment was gradual, a load or two of sand or shell in a low area, raw sewage and household wastes from a few homes, refuse and oil from passing boats or waste products carried downstream from industrial plants.

In most cases, these accretions of human habitation did not greatly alter natural conditions in the estuaries.

However, as populations have increased and technological advances have made bigger and better machines possible, not only have the large estuaries in metropolitan areas like the Hudson River in New York City and the Delaware River below Philadelphia become polluted beyond any resemblance to their natural conditions, but also, smaller estuaries are threatened all along the coast.

Changes are occurring at a much higher rate now than they did 20 years ago. Here in Georgia, it seems to me we should have two objectives: first, to clean up areas where pollution has become extensive, such as at Savannah River; and, second, to practice conservation in areas that still approximate natural conditions, such as in the lower Altamaha.

Biologists can be particularly helpful in pointing out the changes which are harmful to the animal and plant life of an area and how these changes may affect man.

I am not advocating that all estuaries be set aside as wildlife preserves, but a program must be set up for the optimum use of our estuarine resources. It is not in the best interests of man to pollute the waters and fill in all the marshes of estuaries.

The water needs to be pure enough to support plant and animal life. Estuarine animals of direct use to man are fish and shellfish harvested by commercial and recreational fishing.

Striped bass and shad pass through estuaries to spawn upstream and the young, in turn, move downstream to the ocean. Oysters are an estuarine crop, but are edible only when collected from unpolluted water.

Certain rare species of scientific significance occur in estuaries. In addition to these obviously useful animals, there are many minute plants and animals which must exist in sufficient numbers in the water and on the bottom to serve as food for the larger animals.

Not only are waterways of an estuary valuable to man, but also, open areas of undisturbed marsh land should be preserved. They act as a natural means of flood control, providing a large area into which seasonal high waters can overflow without damage to inhabited areas.

Such wetlands and their tidal creeks provide reservoirs of energy and food for animals, particularly migrating water fowl, and are breeding grounds for many kinds of animals, such as blue crabs, oysters and the prized shrimp.

The plants and animals of the estuarine waters and marshes of Georgia are in danger from the encroachments of man. Some of these environmental alterations are obvious; others are more subtle.

I have seen both types of change take place in the estuaries of Cape Cod, Massachusetts. As the human population increases, more and more raw or improperly treated sewage is discharged into the rivers.

This is particularly harmful to the shellfish industries; the estuary of the Altamaha River once had the highest concentration of oysters anywhere along the coast, but is has been closed to the oyster industry because of the high concentration of coliform bacteria.

There may be pollution from industrial wastes. Fish kills may result, but in some cases, the waste products do not directly kill or harm organisms but instead stimulate the growth of noxious microorganisms and otherwise seriously disturb the balance of nature.

This type of nutritional stimulation is known as eutrophication and is a field of modern biological research. Another type of industrial pollution is the thermal contamination of rivers and estuaries, particularly characteristic of atomic power plants.

Aquatic life may be killed directly by hot water discharged into a river, or the survival of certain species may be threatened by interference with their reproduction.

In addition to the quality of the water, the condition of the bottom, the substratum, of estuarine environments may become so altered as to constitute a type of contamination.

As interstate highways traverse rivers, soil is loosened and carried downstream. As harbors and marinas are dredged, the bottom is disturbed and shifted.

The resultant sedimentation may smother bottom-dwelling animals or make the substratum so unstable that life there becomes very precarious and finally impossible.

Thus, a source of food may be eliminated or so curtained that the fish population decreases. Or silting may interfere with natural drainage patterns causing the accumulation of stagnant waters with all the harmful and unpleasant effects of such a condition.

Not only may waterways be altered by the relatively natural deposition of sediments, but man may deliberately fill in marsh lands or dredge out one area and dump the spoil elsewhere.

This type of disturbance may not seem to be pollution, but such alteration of a unit as large and complex as an estuary certainly threatens the organisms within that unit and so may be considered a pollution of the environment.

It is not enough merely to list some of the pollution problems related to estuaries. An understanding of the basic biological and geological principles involved and a knowledge of how our other states are handling similar situations should help Georgia establish a plan for the management of her estuaries.

Research is being done on waterways throughout the United States, and many of the findings can be applied to estuaries in general, but there is much research which needs to be done on estuaries in Georgia.

We have a few large rivers here, rather than the many short ones on Cape Cod, Massachusetts, and we have more extensive coastal marsh lands in the southeast than occur in northeastern United States.

Such research is not a task for an individual, but rather for a team or cooperating groups made of individuals representing such fields as biology, geology, oceanography, soil conservation, fish and wildlife management and harbor and river engineering.

While additional facts about local conditions are desirable and necessary, some control measures need to be initiated quickly. Certain changes in nature are irreversible Extinct plants and animals cannot be resurrected, and a drained and filled marsh, now a motel site, cannot soon again be a place for redwing blackbirds to nest, migrating waterfowl to rest and feed, or small bottom-feeding animals to live and reproduce and fulfill their destiny as a part of the food chain for larger animals.

Standards of water purity can be established based on present knowledge of the nutritional needs of estuarine animals. The standards for estuaries may need to be different than those for fresh water farther upstream or for water used for human consumption.

It must also be remembered that some industrial wastes may be carried downstream and accumulate as toxic materials near the mouths of rivers. All industrial wastes, therefore, whether they enter a river upstream or in the estuarine region, should be monitored as to possible toxic effects.

Concerning the excessive heating of natural waters adjacent to power plants, I understand that cooling towers can be constructed, but at excessive cost. If we want productive rivers and more and inexpensive electric power, it may be advisable to seek federal or state funds to subsidize such towers.

The epidemiologists assure us that presently there are controls and regulations that do prevent any pollution which would affect the health of Georgians.

We are happy to know that the pollution problem has been successfully controlled to this extent, but pollution can affect our lives in other ways than to cause human diseases.

An industrial plant may discharge an effluent into a river which is not directly injurious to man, but miles downstream shad fishermen may lose their nets because of a growth of slime bacteria in the water which was stimulated by this same effluent.

Changing the drainage pattern in an estuary may provide breeding grounds for mosquitoes which then become a plague to nearby residents. I understand that a school in coastal Georgia was closed for several days for this reason.

The ecologists and geologists do not know all the answers, but they are trained to anticipate and solve these problems and have a background of experience and a reservoir of knowledge upon which they can draw.

Finally, there is a great need to educate people as to the dangers of uncontrolled use of estuaries and the need for enlightened management of them.

There will need to be laws passed so that control measures can be enforced, and it will be necessary to have an informed and cooperative electorate to ensure this.

The people of Massachusetts have laws to protect their estuaries and they are effective. Recently there was a headline in a local Cape Cod paper: "Marsh Dredging Seen Threat to Shellfish," followed by another several weeks later, "Threat to Shellfish Cited, Selectmen Deny Permit for Dredging of Marina Basin at Wild Harbor."

Statements by the shellfish warden and the Conservation Commission and the testimony at a public hearing were quoted as being the reasons for the denial of permission to dredge.

This example is of interest not only because the community is practicing zoning of an estuarine area, but also calls attention to the fact that there is a shellfish warden who is a town officer with power to enforce regulations concerning the management of shellfish.

I hope that here in Georgia we can learn how to maintain a balance of nature so that we can have our cake and eat it too -- have industry and recreation and human habitation and yet still keep some of the natural attributes of an estuary.

With adequate planning, it should be possible for the estuaries of Georgia to be "happy lands," places where commercial and sport fishing, industry, municipal expansion, tourism and recreational activities can exist side by side, but still leave certain areas in their natural state for the use of non-human inhabitants which also have the right to live in this world. Thank you.

MR. THOMAN: Thank you, Dr. Burbanck. Gentlemen, do you have any questions?

MR. TRAINA: Yes. Dr. Burbanck, you mentioned, in terms of research, the multidiscipline approach that is required -- I think implied in that is a multigovernmental approach -- research being conducted at various levels of government.

Do you have any suggestions on how this can be done?

DR. BURBANCK: Yes. There is a paper by a man named Darnell that actually speaks to this point, that apparently no particular discipline or no certain individual has the competence or actually the energy to be able to carry on these studies single-handed.

A small example of this is one that we are initiating ourselves at Emory with the Altamaha drainage base, where our biochemistry, geology and biology departments cooperate.

This doesn't mean that these three disciplines are going to answer all the questions, but this is a starting point. We have had, since the initiation of this program, people communicating with us in every way, by letter, by telephone and by coming to see us about offering their services in working, in this particular case, in Georgia's own rivers, because, of course, it is all in the State of Georgia, which makes for a great river somewhat of a unique situation.

So that is just a beginning. Also, I think, in some cases, it's possible to cooperate with already-existing programs. For some years, my colleague, Dr. Robert Platt, has been working in the out-crop area in the vicinity of Atlanta, that is, Stone Mountain, Mount Arabia and Mount Panola, which are the headwaters of one of the tributaries of the Altamaha.

Arthur Allen, at Emory, and I have been interested in estuaries for a long time, so in this case, we tried to weld together our two interests. We can't do this immediately.

It's going to take a long time, probably longer than we will be active professionally, but it's a beginning, and we will be working toward each other. He, too, is working with geologists and biochemists to do, hopefully, many of the kinds of things that Dr. Odum has so very well outlined.

The matter of model building is a very important part of our life today, because although each estuary is unique, it's not going to be possible to study every single one.

But if we can find some common denominators, we may be able to speed up the study of a particular one, and they probably are going to have to be done regionally, because what we do here may have no bearing at all on the Columbia River in the northwestern United States, although, as Dr. Odum pointed out, some of the findings of the Marine Institute of the University of Georgia on Sapelo Island have been useful in Massachusetts.

And here again, in Massachusetts, we have, for the first time, I believe, actual laws controlling estuaries, so there has been a reverberation between what's done up there and what's done down here.

And we have a precedent that might very well be followed elsewhere in the country. It is a wonderful thing that this has taken the form of laws and is a program that's going on in Massachusetts, because it points out this is something that actually can be done, and that's the important point.

MR. JENSEN: Doctor, you have stressed a need for the development of a state management plan, or at least for a management plan for the state's estuaries.

Do you feel that there is an adequate information base at the present time to do this?

DR. BURBANCK: There may be an adequate information base, but we are all working somewhat independently at the moment. And I think one of the most important aspects is for us to have interaction, for industry to know what science is doing and for science to know what industry is doing, so that the left hand knows what the right hand is doing.

I think this is one of the crucial problems. It's not industry as a bogeyman or something like this, and that the biologists are living in an ivory tower, but there needs to be knowledge of one group of what the other one is doing.

Here is a beautiful example of the beginning of cooperation. About three weeks ago, I think it was, Georgia Power invited a group of my colleagues and me to meet with them, and we spent the afternoon talking about our common interests, and I think something fruitful will arise from this.

So I think it's a matter of coordination. We may have all the elements here, but there really hasn't been time to put them together. But the fact is, there isn't too much time.

MR. JENSEN: Act now and make revisions later, if necessary?

DR. BURBANCK: We may have to, and it might be too drastic now, and then, as Dr. Kimble mentioned, continue to modify. As pointed out in the case of the Delaware, which is an open sewer, or was -- it's better now -- there are some points where you can no longer return.

And, as I have mentioned, once animals are dead, they can't be resurrected. We have, for instance, the anadromous fish. They are not found in the world anywhere else.

As far as some people are concerned, if they have no practical value, they are not worth anything. This is not so, because these animals are natives of the Altamaha, and their very life and existence depends on the conditions in the Altamaha, and there is much to be found out about these fish and organisms that are found in the Altamaha.

MR. THOMAN: Thank you very much, Dr. Burbanck.

I would next like to introduce Mr. L. Paul Maggioni, owner of L. P. Maggioni and Company.

MR. L. PAUL MAGGIONI: Gene, Paul, and other members of the panel whom I haven't yet had the pleasure of meeting, ladies and gentlemen: I didn't come up here with a prepared statement.

I only came up here as a member of the seafood industry. I presume that most of you people are native Georgians or you have lived around here most of your lives, and if I talk over ten minutes, somebody hit me with a spitball, please.

This is a pretty long story, and I hope I can get it out quickly. I first started working in 1935 in one of our shrimp canneries down in Brunswick. At that time, there were at least a dozen canneries of oysters in the State of Georgia.

Through the years, I have watched these oyster canneries gradually go out of business. As far as our operations are concerned, our company was originated in Savannah in 1870.

It's a family business. We are still operating. But unfortunately, we have been forced to operate in South Carolina, due to quite a few circumstances: pollution, politics and various other things.

Back in those days, everybody who was in the industry was enemies. They wouldn't speak to each other. But the first thing you know, the depression came along, or part of it was already in progress, and some of them started dropping out.

One or two of the larger ones bought up the small ones and so forth, and gradually they were falling by the wayside. Well, sooner or later, there were only a few.

Then we started realizing that we all had similar problems and perhaps maybe if we stuck together, we would be a little bit better off, but that wasn't the case.

We stuck together, but the oyster canners continued to go out of business. Today our company is the only company on the Atlantic Coast canning oysters.

Now, that makes us feel pretty lonesome. We have seen this pollution problem gradually encroach upon us. We have seen our supply of oysters gradually dwindle.

Without clean water, we won't be here too long either. We are the last ones on the Atlantic Coast. The handwriting is on the wall. I think that people have been splitting hairs a little bit too long.

I think that it's time now that something is going to have to be done and done quickly. There are other areas too that are confronted with the same problem as we have, and as far as our company is concerned, we plant or replant about 80 percent of all the oyster shells we plant in the State of South Carolina.

That's where the best fishing is, believe me. There's nothing else that I can add, except that we have got to do something. I'm sorry that we have to go to Japan to get these experts on oysters, because our oyster experts are just dwindling away, but we know a little bit about oysters too, and there are a few practical things that must be taken into consideration.

We can put them on rafts, but we can't stop those people from taking the rafts. Our laws don't protect the rafts. Thank you. That's all I have to say.

MR. TRAINA: Concerning laws, as an oyster producer and harvester, what are the problems you face regarding the legal aspects of wetland ownership, whether it's in Georgia or any other state, for that matter?

MR. MAGGIONI: The title to land in the State of Georgia primarily goes to the low-water mark. In other words, if you want to buy a piece of salt-water property, you buy title to the low-water mark.

In South Carolina, the state controls all tidelands unless the owner of the adjacent land can show a land-grant title -- this is an original King James land grant.

Therefore, the State of South Carolina controls nearly all of the tidal areas on which oysters are grown. In Georgia, that is not so.

Now, when we were operating in the State of Georgia, we could go to maybe two or three people and acquire the oyster rights for enough acreage to operate commercially.

Now, these people died out over the years and left their property to heirs. And one man will die and leave his property to four or five heirs, so instead of dealing with one man in acquiring oyster rights, you have to deal with four or five, so the multiplication of ownership has sort of decreased the amount of commercial valuable rights and also made it more difficult to retain the rights.

In South Carolina, that's different. The state controls it, and then you renegotiate with the state as your leases expire.

MR. HOWARD: I would like to make a comment. I'm from Savannah, too, you know, and I remember as a young fellow where we had four or five big commercial shellfish harvesters, including you folks, and Lowden Brothers and so forth.

MR. MAGGIONI: You also remember we were all considered criminals.

MR. HOWARD: I can remember when we used to be able to go down to the river most any time and catch all the fish we wanted. We can't do that now, because of sewage going into it.

We do have a program now to improve the situation in Savannah, as you know. We are going to have to have the support of the people to enforce the law, of course.

MR. MAGGIONI: They are going to have to quit splitting hairs and get down to brass tacks and get this thing done. It's got to be done quickly.

MR. HOWARD: We used to have the best oysters down around Wilmington Island.

MR. MAGGIONI: And you could go down there and eat oysters any time you wanted to, but now you can't do that. We are told where we can't get them. We are the only ones that know where the polluted areas are.

So if anybody else goes in the river or goes down and tries to get an oyster and eats it, he's in trouble.

MR. JENSEN: Paul, I would like to hear a little bit more of your thoughts on the impact of pollution on the oyster industry of Georgia. Is this the major thing that has --

MR. MAGGIONI: The way I like to look at it is this, we know that the best fishing drops are on the old shell reefs. You know that. Everybody knows that.

If you don't have any shell reefs, you don't have any oysters. If you don't have any oysters, you don't have any shrimp. If you don't have any shrimp, the fish won't bite.

It goes right back to that same old cycle -- pollution is a factor in a lot of respects. Now, for example, a friend of mine asked me two days ago if I wouldn't try to have something done about people pumping out their bilges near one of his favorite fishing drops.

He didn't like someone pumping out -- I said, "Why?"

"The fish I catch taste like oil."

This fellow is employed by one of the biggest pulp mills in the South, he is a big-salaried man, and he wants me to do something about stopping the pumping out of bilges.

Now, I was around when the bilges were pumped by hand and the boats were all run by sail. (Laughter) I have got hair, but I have been around that long. (Laughter)

MR. THOMAN: Thank you very much.

DR. BURBANCK: I would like to make two points. One, about the number of oysters here. I know you have Paul Galtsoff's book on oysters, which is a classic, but in it, he has a picture which he said was the biggest oyster bar he had ever seen in the Altamaha Sound, and that was the basis for my comment here.

And Item Number 2, about the things that have to be done when Mayor Tailer says that Darien and other communities are dumping raw waste into our waters and thus contaminating the oyster beds.

I don't think any of us would touch these with a ten-foot pole if you have a high coliform count. There are places where there are high coliform counts where there aren't any people around at all.

Now you wonder where that came from and whether that is serious, and that's the point I'm making. In some places, we may have to have other criteria -- coliform bacteria may be coming from porpoises. They are mammals.

MR. MAGGIONI: Maybe from ducks.

DR. BURBANCK: But you see, we have set up a rigid --

MR. MAGGIONI: Yes, they could come from ducks, and we --

DR. BURBANCK: We really don't know, but we have got this one point, coliform bacteria are dangerous, and in many cases, if not most, these are fecal wastes which might have typhoid, or dysentery, or whatever.

But on the other places where they are isolated, I think we have to find out where those coliform bacteria come from and if they really are dangerous, because these oysters may be perfectly all right.

MR. JENSEN: Paul, where is this bank of oysters now?

MR. MAGGIONI: It's not there.

MR. THOMAN: Dr. Singer had a question.

DR. SINGER: As a representative of the oyster industry, I would like to ask you an economics question. To what extent could you sell oysters if you were to increase the harvest considerably?

What factor do you project -- I'm trying to keep the situation in balance here.

MR. MAGGIONI: We never pack enough oysters to take care of our trade. Of course, we have a limiting factor, which is labor. Our oysters are gathered by hand, being intertidal oysters coming off the bank.

We have dredging laws. We can't dredge on mud banks, because that would naturally create a settling process and would kill oysters -- oysters that we didn't dredge would be killed.

So in South Carolina, there is a law against dredging on these banks. Now, there are no deep-water oysters in commercial quantities in South Carolina, due to the presence of what they call Polydora, which is a worm, and a fungus.

I think Mr. Jensen knows what that fungus is. I don't know what they call it. And so the deep-water oysters have died out or have been killed out, but the bulk of the oysters has always been the tidal oysters.

We never get enough oysters in to take care of our demand. Thank you.

MR. THOMAN: Thank you very much.

MR. HOWARD: Jack, I would like to make a comment about what Dr. Burbanck said about coliform bacteria. I think it is a ridiculous fact that some of our oyster beds are closed now because of signs of coliform.

We do have some areas down around Savannah that would be pretty good for oyster harvesting. If we used a fecal coliform index to determine pollution in our shellfish or if we had a more total coliform index, we could probably open up some areas for shellfish harvesting.

DR. THOMAS L. LINTON: I want to make a comment in regard to Dr. Singer's comment a while ago. There has been a 40-fold decrease in the production of oysters in the past 50 years.

MR. TRAINA: I have a statement from the Oyster Institute, and I wonder if it would be appropriate to read it now. We just received this this morning from Mrs. David Wallace, Director of the Oyster Institute of North America.

"Mr. Thoman, members of Georgia's Water Quality Control Board, participants and guests of this FWPCA hearing: The Oyster Institute of North America represents the producers, processors and dealers of clams and oysters of our country.

"The most essential factor in producing molluscs is clean water. The Water Quality Act of 1965, established the 'marketing of shellfish' (PL 88-234, Section 10) as the criterion for water quality.

"The law and the subsequent laws -- the Clean Water Restoration Act of 1966, the Marine Resources and Engineering Development Act of 1966, the National Sea Grant College and Program Act of 1966 -- passed because the citizens demanded that their environment be restored, and that all of us have the privilege of profiting from the beneficial uses of water.

"The potentials of oceanography are recognized in Georgia by the establishment of your new laboratory at nearby Skidaway Island.

"The best minds in the sciences comprising the concept of oceanography are unconditional in their evaluations that the real wealth is in the estuaries, the close-to-shore waters that can provide recreation and an abundance of food.

"Seafood is the most nutritious you can eat. It contains the trace minerals long lost by erosion to land-produced fruits, vegetables and meats.

"Any high school biology student knows that molluscs are the most complete food, notwithstanding the promotion of the milk industry.

"Georgia has enormous potential in its tidelands areas for oyster production. This capacity is grossly underutilized because of land laws and polluters.

"Our Georgia Director, Mr. L. Paul Maggioni, can be specific on the reasons that Georgia produces a few oysters in comparison to neighboring states.

"We sincerely hope Georgia will take the long-term selfish, enlightened view that this hearing provides an opportunity to use the environment in the best interest of all of the citizens.

"Polluters are powerful, but vulnerable to aroused public opinion. The cost of waste disposal must be built into the cost of the product.

"It is the law of the land. We trust the informed citizens to back their state officials to achieve Georgia's rightful heritage."

MR. THOMAN: I would next like to call Mr. Miller A. Dial, the President of the Georgia Association of Soil and Water Conservation Districts.

Mr. Dial, I believe you are representing some other people today, too.

MR. MILLER A. DIAL: Right. I'm also representing Mr. Jim L. Gillis, Chairman of the Georgia State Soil and Water Conservation Committee, which is closely related with the Georgia Association of Soil and Water Conservation Districts.

The 27 soil and water conservation districts which cover the entire State of Georgia are state agencies established under the Georgia State Soil Conservation Act of 1937.

This Act also established the State Soil and Water Conservation Committee and outlined its responsibilities for leadership and guidance of soil conservation districts and soil and water conservation programs in the state.

The erosion of agricultural lands in Georgia have contributed to the silting of our estuarine areas, but soil and water conservation measures installed on lands within the state, through the conservation district program, have reduced the turbidity, or muddiness, of waters in the major streams which affect estuarine areas on the coast.

Intake water turbidity records maintained by waterworks at Atlanta, Augusta, Macon and Milledgeville show a dramatic downward trend for the 30-year period since districts were organized.

The average annual turbidity of raw water varied from 200 to over 400 parts per million in the middle '30s, to consistently under 100 parts per million in the 1960s.

The major contributing lands to siltation of river waters in the state at present are highway rights-of-way and urban developments. Joint research by state and federal agencies has shown that as much as 359 tons of silt can be washed from an acre of exposed highway bank in a single year.

A more aggressive approach, including technical and financial support from every source, must be taken to adequately treat, with conservation measures, the thousands of miles of roadbanks contributing to the pollution of the rivers and estuarine waters of Georgia.

Nutrient enrichment is attracting attention because of the excessive production of aquatic plants which ruin water for recreational and domestic uses. The source of this accelerated growth is attributed chiefly to the increased availability of nitrogen and phosphorus.

Agriculture is frequently blamed as a contributor of these pollution problems as a result of increased fertilizer use and concentrated feeding of livestock and poultry.

However, accurate, quantitative information on the magnitude and source of agriculture's contribution is not available.

It is essential, therefore, that a research program be developed which will evaluate soil and water management factors affecting the movement of nitrogen and phosphorus from agricultural lands into estuarine areas through surface and ground waters.

The State Soil and Water Conservation Committee and the 27 soil and water conservation districts believe that the estuarine areas of Georgia are economically valuable and that they should be protected from pollution and unwise use, such as filling for commercial purposes and diking for fresh-water ponds.

I thank you for the opportunity to make this statement.

MR. THOMAN: Are there any questions? If not, I would like to call on an esteemed friend of mine, Dr. C. E. Kindsvater from the Georgia Institute of Technology.

He is also the Director of the Georgia Water Resources Center.

DR. C. E. KINDSVATER: You will be pleased to know that I have just handed Jack a ten-page statement and that I will attempt in a very few words to abstract some of the thoughts expressed in that statement.

Georgia Institute of Technology is pleased that this study, of which this meeting is a part, has been designed to emphasize total estuarine environment and the extensive external effects of a comprehensive management program.

We are pleased that it recognizes the need for a partnership approach to the solution of estuarine problems, because the solutions, like the problems themselves, must involve all levels of government, as well as private interests, organized citizen groups and individuals.

In our formal statement, we have stressed the facts: First, that an effective estuarine resources management program must be based on a good understanding of the nature of the problem; and second, that natural estuarine systems, let alone those which are grossly affected by man's activities and man's ever-changing needs, are among the most complex and least understood of all the environmental problems; and third, that a large part of a national estuarine management program must consist of research which will lead to the development of new knowledge and new methodology.

For purposes of describing our concepts, of the nature and magnitude of the problems, and the research needs, our formal statement defines estuarine zones in terms of four factors: First, hydrologic, hydraulic and geologic factors involved in the development of the physical characteristics; second, biologic and chemical factors, which influence the physical as well as their ecological characteristics; third, those specific man-made pollutional factors and effects; and fourth, socioeconomic and institutional factors resulting from man's occupance of estuarine regions and his utilization of their resources.

Finally, in our formal statement we have described the specific competence of our nation's colleges and universities as active participants in the estuarine management program, particularly their competence to engage in interdisciplinary research.

And we recommend that they be engaged to participate in the program within the limits of their resources. And, because research and education are inseparable, I can assure you that the universities will respond. Thank you.

MR. THOMAN: Thank you very much. Are there any questions?

MR. JENSEN: I have one.

MR. THOMAN: Go ahead, Gene.

MR. JENSEN: I would like your thoughts on the desirability of establishing an estuarine technical information center. It seems to be that the literature in the field now is spread around through so many different areas it's very difficult to find -- and you're never sure how much of it you have gotten.

Do you think perhaps within the framework, say, of the Office of Water Resources Research we may establish an information system that would help to bring together much of the estuarine literature into a single place?

DR. KINDSVATER: I certainly think it's needed. This lack of communication is a real problem. As you know, I'm sure the Office of Water Resources Research is getting under way a water resources information service, and it would seem appropriate that in combination with the Science Information Exchange and this new Department of Interior service, that estuarine literature and estuarine information be better coordinated.

MR. JENSEN: Do you think this could best be done within the framework of the water centers, or would it be desirable to structure one specifically for the estuaries?

DR. KINDSVATER: There is much misunderstanding regarding the 51 water resources centers. Jack introduced me as the Director of the Georgia Water Resources Center. I am not.

I am the Chairman of the Joint Tech.-Georgia Coordinating Committee for Water Resources Research, which is concerned only with Title I of a very limited research activity, funded to a modest degree under the Public Law 88-379.

What I'm saying is the so-called state water centers do not have the authority to perform multijurisdictional coordinating activities.

DR. ODUM: Several years ago right here in this room we had a national conference on estuaries, and there were considerations here from all the various areas that you mention.

DR. SINGER: I have a question, and I would like to invite representatives of other academic institutions to join in on this question.

You mentioned, of course, the special competence of institutions to engage in interdisciplinary research, and it was also mentioned, the dedication of universities to deal with the important local problems, particularly the estuaries.

My question is as follows: Looking at the very mechanisms that are available now in federal government to aid in establishing these research centers, would you say that they are adequate, specifically the Sea Grant College Program which was set up recently by the Act of 1966?

Does it seem to you to be an adequate mechanism to establish these estuarine research centers that you feel are needed, or would you want the federal government to investigate different mechanisms, further mechanisms, or new ones?

DR. KINDSVATER: I would hope they would investigate the very challenging problem of better coordinating all of the federal programs.

DR. SINGER: Let me follow this point up. I think it's an important point. We do want to get your input. We hear, on the one hand, statements from the university people that they would like to have a little less coordination, in the sense they would like to be able to go to different government agencies for support, they would not like to see it all centralized in one channel of support whereby Uncle Sam helps the university.

They would like to have a little variety, so that if they do not have a satisfactory match with, let's say, the Natural Science Foundation, they can get the support from the Office of Water Resources and so on.

DR. KINDSVATER: Well, there very certainly is this aspect to engage in these different agencies. The only way you can get around cliques, control groups and so forth is perhaps to go to a variety of different funding agencies.

I have only learned late in my career that coordination can be a dirty word. I used to think it was like motherhood and Christmas and that sort of thing. (Laughter)

But I have devoted the last nine years of my life to interdisciplinary efforts, and it is an extremely challenging problem for which we have need for much research and experimentation.

MR. THOMAN: You have lost a little hair during that period, too.

DR. KINDSVATER: I have, but it's been fun, though.

DR. BURBANCK: Dr. Kindsvater, you mentioned the importance of universities cooperating. I raise a somewhat practical point at this time. I wonder if the things we are talking about are not of enough importance to our nation, our states, and the world, as far as that is concerned, that some of them ought to be able to complete their work.

Now, many laboratories where they have assistance as part of the program, they're going to continue, at least I hope they are. But the universities that are operating in many cases with graduate students are in a serious problem, because what will I do if these problems that have been started -- say, for instance, a man going away to defend his country.

I hate to turn this over to someone else. When he comes back, he might like to start where he left off. And then again, he might not come back, or his work may be so crucial that his work has got to be done right now.

This is a problem that has got me over the barrel right now. The women can't do all the work. Much of the work that has been going on is quite rugged.

Granted, girls can do a lot of things that we didn't think they used to be able to do. But I was wondering in your case how you are handling this question.

DR. KINDSVATER: Well, we anticipate a 20- to 25-percent reduction in our graduate enrollment as a result of the recent ruling regarding drafting of graduate students.

I think this is something that does deserve the attention of such groups as this, because in the long haul, we are concerned about a continuing production of highly competent researchers, teachers and workers in all of these fields which we have been speaking about today.

MR. THOMAN: Dr. Burbanck, our report is not going to Congress until November, 1969, and I think all of us are praying that by that time the thing to which you allude and recent orders will be down the drain.

I sympathize with you, but it seems this is in the province of General Hershey. Thank you, Professor Kindsvater.

Since this has been a male-dominated thing, I think we should make it coeducational. Miss Carroll Hart of the Atlanta Bird Club would like to be heard this morning for some personal reasons. Miss Hart.

MISS CARROLL HART: Even though I represent the Atlanta Bird Club, I want the gentlemen of the panel to know that I know something about digging oysters out of the banks, and I think this region of Georgia is one of the most fascinating and one of the most wonderful that we have.

I spoke yesterday with one of our most outstanding state officers, who in the 1930s, introduced a bill to control water pollution, and he told us how he was laughed at and ridiculed in the Senate at that time.

And he said, "I don't know what these people can accomplish, but I hope this hearing will do something, because if it doesn't, the time will come when we will have an epidemic and it will take that to make people move."

I speak for the 400 members of the Atlanta Bird Club, whose interest in the welfare of mankind, the conservation of wildlife, and the preservation of our natural areas heritage prompts me to voice their protest at this hearing.

Estuaries, since the first days of America, have played an important role in the history of man.

In the rich gold countries, the Spanish fleet's explorers found new riches along the estuaries. This was our first frontier.

The estuaries became the doorways to colonization along the eastern seaboard. Through protective waterways, the early boats of commerce traveled.

Here colonial America took root, and man lived on the abundance of fish and wildlife he found. Shell mounds reaching to a height of 40 feet attested to the richness of this land.

In a balanced ecology, too early for man's destructive waste, the land and the water supported life. Today we may look upon our estuaries as our last frontier.

Tourists should be drawn to study, and picture and exhibit the meeting of fresh and salt waters in this complex estuarine environment. Where are the boats that raced on the rivers, the boys who swam the strong currents?

Where are the local fishermen who set out from the docks in small boats each morning to fish and gather oysters? Where are the flocks of wild ducks which came in the fall and the many small birds that inhabited the marshes?

They have almost vanished, with the pollution of estuarine waters. The Atlanta Bird Club protests to this pollution of our estuaries by harmful insecticides washing from agricultural lands into the streams and by industrial waste poured into the rivers, by sewage released by cities and towns.

Pollution is causing the slow death of one of Georgia's priceless resources, her estuaries. The Atlanta Bird Club recommends that responsible citizens, civic, conservation, recreation and history-oriented groups and institutions of learning, aquatic research bodies, local industrial shipping interests, unite to save the estuaries through regulations for an industrial control of all types of estuarine pollution.

Local, state and federal support must be aroused for this undertaking. Thank you.

MR. THOMAN: Thank you very much, Miss Hart.

I would next like to call on Mr. Howard J. Sears, representing the Commissioners Roads and Revenue of Glynn County, Brunswick. Mr. Sears.

MR. HOWARD J. SEARS: Thank you. The Board of Commissioners has long been aware of the immense value of the estuarine areas of this region, both social and economic.

Recent studies of the Brunswick - Glynn County Joint Planning Commission have documented this awareness. These studies indicate that there are more than 95,000 acres of estuarine area within the county which is approximately one third of the county's total land area.

In addition, the estuaries include literally thousands of acres of shallow open water. These estuarine areas provide the nursery grounds and habitat for the shellfish which contribute heavily to the local economy.

An annual catch of one million pounds of shrimp provides the basis upon which a major processing industry has been formed. One third of the area's manufacturing workers presently work in seafood processing, including almost 1500 women, or 85 percent of the local females employed in manufacturing.

Although the county's crab harvest is not as great as the shrimp harvest, it is significant enough to support two local crab processing plants.

In order to catch the fish to supply these processing plants, there are some 75 vessels registered locally. The actual fishing operations employ more than 400 people with a combined income of about $850,000 annually and an additional investment of $950,000 in boats and related shore facilities.

While very little is known of the impact of pollution on the present shrimp and crab harvest, we do know that there is not now any commercial clam or oyster production, due primarily to the pollution situation.

Much of Glynn County's appeal for tourists, conventioners and retired persons is directly related to the quality of the estuarine environment.

While the major charm of sport fishing and water fowling is the sheer pleasure of sun and salt air, most practitioners want some assurance that their game is present in adequate numbers and healthy.

It almost goes without saying that a major part of the local economy would be severely damaged if pollution were allowed to discourage our visitors, as well as our local sportsmen.

And it follows that the elimination of existing pollution would certainly tend to increase the potential for our future recreation development.

In addition to commercial fishing, as well as recreational hunting and fishing, unpolluted estuarine areas make many intangible social and educational contributions to the community.

Bird watching and nature study are of interest to tourist and local resident alike, but their impact cannot be computed. We do know, however, that these pursuits are important and should not be allowed to disappear.

The Glynn County Commission believes the time is past when political hay can be made in South Georgia with statements to the effect that pollution is indeed most unfortunate, but that if pollution is a prerequisite to new and bigger pay rolls, then let's have pollution.

Pollution is not necessary, and pollution to a destructive extent is indefensible. Anti-pollution measures to insure clean water may be expensive to initiate, but failure to initiate them, especially when an area has so much to lose as Glynn County, can only prove infinitely more expensive in the long run.

The Board of Commissioners directs your attention to those steps now being taken by local industries to reduce and eventually eliminate their industrial pollution.

Also, both the county and city governments have provided primary treatment for sanitary sewage, and plans are under way to provide secondary treatment.

In addition, the County Commission is committed to find the means to provide treated sewage disposal for the urban areas north of the City of Brunswick which are not presently serviced.

MR. HOWARD: I would like to say, we commend Glynn County and the City of Brunswick for what they have done and for what they are doing.

MR. JENSEN: I wonder if you would care to say anything additional about the role of community planning and the relationship of county planning, for example, to a broader state plan for the use of the estuaries.

MR. SEARS: Well, I am not as informed as maybe I should be. This county has had planning -- zoning -- since 1927. We now have what is called the Coastal Area of Planning and Development Commission, which plans for a coastal area.

DR. SINGER: This Coastal Area Planning and Development Commission that you just mentioned, how much of the coast does it cover?

MR. SEARS: It embraces five counties: Camden, Glynn, McIntosh, Long and Bryan.

DR. SINGER: Where does it derive its authority from?

MR. SEARS: Through state planning acts and encouragement. I think Mr. Maney, who is present, might help me out. We contribute financially on the basis of 25 cents per capita on our present 1960 federal population studies to the financing of this group and the state matches these moneys through the Industrial Development Commission.

I believe that is the agency.

MR. JENSEN: Do you see any federal role -- is there any reason for the federal government to be involved in this type of community planning?

MR. SEARS: Our area goes down to the Florida line, and the coastal area of Camden County and Glynn County itself, of course, is surrounded by other counties, so the direct role, as far as the problems of intervening state lines, we don't have in this particular area: which would be the area that I would think the federal government might have a part in, other than research and an accumulation of information.

MR. TRAINA: Mr. Sears, do you see the role of local government in promulgating rules and regulations on estuarine management?

MR. SEARS: Yes, I do.

DR. ODUM: Could I say something here about zoning?

MR. THOMAN: Go ahead, Dr. Odum.

DR. ODUM: We just had a study made by some law students about this, and the general idea seemed to be that zoning will work in the long run only if there is also some acquisition of rights for this property.

In other words, zoning in cities doesn't work too well, because if there is hard pressure, it's difficult for zoning boards to do it. But if the city itself owns the rights, owns its estuarine rights, as South Carolina perhaps does, then it's much easier to enforce the zoning, and this apparently is what the legal opinion now is, that acquisition of rights or actually acquisition ownership of the area is, in the long run, more effective as adjacent to zoning.

Would you agree with that?

MR. SEARS: Dr. Odum, I'm sure you're right.

MR. THOMAN: Thank you very much. I would next like to call on William J. Verross, General Manager of the Interstate Paper Corporation of Riceboro, Georgia. He is representing the Georgia Pulp and Paper Association.

MR. WILLIAM J. VERROSS: Mr. Thoman has told you who I am, but I want to make it clear that I am appearing today as the designated spokesman for the Georgia Pulp and Paper Association.

The Association is pleased to have the opportunity to present its views in connection with the National Estuarine Pollution Study provided for by the Clean Water Restoration Act of 1966.

At the outset, the Georgia Pulp and Paper Association, which speaks for 13 mills having a total employment of approximately 10,000 persons, wishes to go on record as favoring clean water and for the conservation of our water resources.

We realize that such statements can mean different things to different people, and to different interests. But as an industry which depends on water for its very existence, we do appreciate the need for protecting and developing our state's water resources, not for our use alone, but for other purposes as well.

The steps our industry already has taken, plus actions planned and contemplated, clearly indicate our willingness to support a reasonable goal of clean water and water resource protection.

As an industry, we have spent many millions of dollars on the development and operation of effective treatment facilities over the past few years, and we will spend more millions in future years.

Georgia paper mills spent $5,100,000 on treatment facilities up to 1965, and have spent or will spend, an additional 6.7 million in 1966 - 1968.

These are not merely industry claims. They are supported by a recent series of articles on water pollution based on a thorough search by the reporter and published in the "Atlanta Journal," which stated: "Industry, especially the pulp-paper and textile industries, have spent literally millions of dollars to treat their plant wastes..."

To the point of the National Estuarine Pollution Study, the Georgia Pulp and Paper Association respectfully submits the following points for consideration:

1. Georgia's laws are adequate. We feel that Georgia's existing law, rules and standards governing water quality -- and the administration and enforcement thereof -- are more than adequate to protect the state's estuaries and coastal waters.

It is generally recognized by both industry and government that Georgia's 1966 Water Quality Control Act is one of the better ones in the nation from the standpoint of water resource protection and development.

The Georgia Act has been implemented by an equally effective set of rules. The Georgia standards for maintenance of water quality were among the first in the nation to be approved by the Secretary of Interior under the federal water pollution legislation of 1965.

There is no question as to the applicability of the Georgia Act, rules and standards to the state's estuarine waters. The 1965 Act defines "waters of the state" as follows:

> "... any and all rivers, streams, creeks, branches, lakes, reservoirs, ponds, drainage systems, springs, wells, and all other bodies of surface or subsurface water, natural or artificial, lying within or forming a part of the boundaries of the state which are not entirely confined and retained completely upon the property of a single individual, partnership, or corporation."

In view of the state's authority and action, we feel there is neither a need nor a justification at this time for further federal regulation of the estuaries of Georgia.

2. More research is needed. We believe there is need for a great deal more research on the ecology of estuaries before additonal regulation or legislation is sought to be imposed over coastal waters.

There is at the present time a lack of supportable scientific data on the ecology of estuarine waters, or, for that matter, on the physical and chemical properties of most estuaries.

But there has been no such lack of nonscientifically supportable statements as to the estuarine ecology, such as, "... the estuary is the breeding ground and nursery for many species of fish and wildlife, and newborn life is particularly sensitive to pollution."

Such statements, no matter how sincere and well meant, simply cannot be backed up at the present time by scientific data.

What our Association asks is that any legislation or regulation for the management of estuarine waters be based on scientific fact, rather than theory.

Indeed, it often becomes a matter of semantics and definitions, for it is scientific fact that certain forms of pollution encourage both plant and animal life.

3. Multiple use is possible and practical. The Association feels that concurrent multiple use of estuaries is possible, and desirable, and practical.

We do not subscribe to the theory that estuaries lend themselves to a single use to the exclusion of all others. We do not believe there must of necessity be a conflict in the use of estuarine waters for recreation purposes and for industrial purposes.

We believe that within existing law and regulation there is ample room for both these interests to reap the benefit of the estuarine water resources.

One need look no further than this Glynn County area for proof that recreational, navigational and industrial use may be made of the same estuarine waters at the same time.

The presence of industry, even several water-using industries, has not prevented this area from becoming a prime recreational area and tourist mecca.

Industry or navigation has not adversely affected fishing in the Turtle River and other coastal waters, or swimming in the surf off Jekyll, St. Simons and Sea Island.

The Georgia Pulp and Paper Association recognizes and respects the great benefits of our state's estuarine and coastal waters for recreation and fishing purposes.

But we also point out that these same estuaries have an enormous economic benefit from the standpoint of industry and industrial growth.

Members of the Georgia Pulp and Paper Association operate six mills on or near estuarine waters. This number will become seven when my own mill starts operations next month.

Together, these mills account for approximately one half of the total daily pulping capacity of the state. They provide direct employment for some 6000 Georgians and have an annual pay roll of around 40 million dollars.

Nor is the economic impact of these coastal mills limited to their own employment or to their immediate areas. They generate corollary manufacturing, commercial and service enterprises; and they provide a market for pulpwood produced in an area comprising almost half of Georgia, as well as adjacent areas of South Carolina and Florida.

We do not describe here the economic importance of the pulp and paper industry in order to disparage the use of estuarine waters for fishing, recreation or other purposes.

But we do believe this industrial importance should be recognized in order to maintain a balanced perspective of the overall development and use of the estuaries.

The important point -- and the only one we make here -- is that there can be concurrent use of these waters for more than one purpose.

We believe any plan of management that may be developed for the estuarine and coastal waters should reflect this point of view in order to achieve maximum benefit of this important resource for the common good of all.

In summary, it is our considered opinion that there now exists adequate and appropriate legislation and organizations to provide for the continued and upgraded protection of this state's estuarine water resources.

There exists now and will in the future a need for intensified research into the ecology and interactions of these estuarine waters. The results of such research will then provide a scientific foundation for the administration and enforcement of a practical and sound program by the established authorities of this and adjoining states.

It is our firm belief that only by this means can these waters continue to adequately serve the people of this region, this state and this nation.

MR. THOMAN: Thank you.

MR. HOWARD: Would you care to comment on what Interstate is doing --

MR. VERROSS: Excuse me, but I am appearing today at the hearing as the designated spokesman for the Georgia Pulp and Paper Association, and maybe I would feel better if I were recalled and then make statements or answer questions relative to our own particular position.

I would rather not answer any questions as a representative of Interstate Paper Corporation while I am up here acting as spokesman for the Georgia Pulp and Paper Association.

DR. SINGER: You believe that multiple uses of estuaries can coexist provided that quality control standards are observed?

MR. VERROSS: I believe that's correct.

DR. SINGER: You did not necessarily express that, but I believe that came out of your presentation.

MR. VERROSS: Dr. Singer, I believe we can take the position that they have coexisted for quite some time, long before any legislation and even long before water standards were in there.

It is possible that, to any particular segment, they felt the standards were not particularly proper or appropriate for their particular point of view, but I think that the estuaries of Georgia, where this paper industry has grown up, have pretty well demonstrated that they have existed -- they have concurrently used these estuaries, whether to the degree of one side or the other is really the point that has to be answered.

We have heard the poor old Savannah River damned here several times, and yet we still have Savannah Beach down from them as a recreational area.

Maybe it's not as recreational as some people would like to see, but basically we do have recreation in the Savannah area. The Association feels that concurrent multiple use of estuaries is possible, and desirable and practical.

MR. JENSEN: You have made your position very clear with respect to water quality and estuarine management. The management, though, of an estuarine resource probably requires more or less concurrent control over water pollution and over physical modification of the estuaries, that is, dredging, filling, construction of channels and such.

The community planning or zoning -- you said that you saw no need for further legislation, at least in the area of water pollution control Would you feel the same way about these other two areas, that is, physical modification and community planning or zoning?

Perhaps you can answer --

MR. VERROSS: It's pretty hard to say. As a member of the Association, most of us, if not all of us in the paper industry, have come into these areas at the request of a particular community in one form or another.

I think that is only fair to state that the community presumably considered all of the impacts on it. It's possible the community made its own value judgment, and as the judgment they decided that they would rather have the industry there.

After all, it's our government, too. It's hard to get used to the idea here that we, as an industry, have to look on government as an adversary. It's unfortunate that it has grown up that way.

It's unfortunate for industry. It's unfortunate for the people who work there. So when you talk about further planning and all, I suppose we, as a part of the planning, would want to have a say-so.

It's pretty hard to answer for a total industry in that respect, but I think planning has gone on.

MR. JENSEN: Thank you.

MR. THOMAN: Thank you. I would like next to call on Mrs. Alan Mather, representing the League of Women Voters of Georgia. We are very happy to have you here today. Mrs. Mather.

MRS. ALAN MATHER: The League of Women Voters of the United States began its study of water resources in 1956, and its soon became clear that management of our nation's water resources needed to be simplified.

We found that there were a multitude of agencies, both public and private, that were concerned with water resources, but there seemed to be a lack of communication between these various agencies, and, in fact, they often seemed to be working at cross purposes.

We have not observed a great deal of change in this situation, and, therefore, we are wholeheartedly behind Section 5(g)(3)(C) of your report to Congress, which says, "The report shall include recommendations for a comprehensive national program for the preservation, use and development of the estuaries of the nation and the respective responsibilities which should be assumed by federal, state and local governments and by public and private interests."

We think that comprehensive planning and a clear delineation of responsibility is important in all water planning.

The League believes that development of our waterways should be undertaken only after consideration of different ways in which the waters can be used and we believe that the executive and Congress should be provided with adequate data so that all alternatives for development can be considered and intelligent decisions made.

We do find it confusing when the Water Quality Act of 1965, requires standards to be set for interstate waters by July, 1967, as has been done, and then the Clean Waters Restoration Act of 1966, sets up this study.

It would seem to us that the information gained in this study would have been necessary knowledge for the department's evaluation of the standards proposed by the states.

We also hope your report will provide estimates of the cost of any proposals. The public needs to have pointed out for them the costs involved in obtaining the conditions they think they desire.

In the final analysis, it is not the federal, state or local government, not even private industry, who bears the cost of improving water quality; it is you and I, the taxpayer and the consumer.

The Delaware Estuary Study provided cost estimates for obtaining various qualities of water, and this proved most helpful.

The League has no specific recommendations to make about particular estuaries along the coast of Georgia. We don't know what the permissible coli count should be, or how many ppm of dissolved oxygen are desirable; but we do know that our estuaries should not offend the visual or olfactory senses of persons in their immediate vivinity.

We are offended by unsightly dyes, odorous chemicals and oily deposits which often cover the waters and there is no excuse for untreated domestic wastes accumulating along the shores of Wilmington Island or anywhere else.

We believe that our estuaries, as well as other waters, should be developed primarily in the public interest.

We recognize that -- with our growing economy and expanding population -- our estuaries cannot all be maintained in the conditions in which the founding fathers first found them.

We do think that local, state and federal agencies should work together to plan for the development and preservation of our estuarine areas so as to permit a variety of desirable uses.

There is no question that we need navigation, industry, commercial fishing, and to retain some estuaries in their natural condition.

Since we feel that some uses are incompatible with others, plans should be developed to identify which areas are best suited to which uses and to maintain the necessary conditions to support and encourage those uses.

Again, may I stress our feeling of the need for coordination and communication between all levels of government and private interests; not only those agencies generally thought of as water resources planning agencies, but also chambers of commerce, economic planning and development groups, both public and private.

Another of our long-standing League positions is that opportunity be given for citizen participation in policy decisions regarding water resource development, and we thank you for that opportunity today.

I would like to make a couple of personal observations that have come up through the discussions today.

MR. THOMAN: Go ahead.

MRS. MATHER: One is in this matter of governmental cooperation. Mr. Jensen has been directing a great many questions to how this could be worked out, and I am wondering if the Office of Water Resources Research, or some one, or maybe a great many people, ought even to be encouraging the political scientists to get into this field of helping to work out inter-governmental relations, perhaps some of them through our water research centers.

Do you have any political scientists in this field at Georgia Tech?

DR. KINDSVATER: I would say that the Office of Water Resources Research is indeed in cooperation with the federal government on science and technology, giving very high priority to socioeconomic political research.

MRS. MATHER: As usual, they are ahead of me. Another thing with which I am sure Secretary Singer and Mr. Jensen are familiar, and that is the public advisory committees that were set up in conjunction with the Delaware Estuary Study, and I think they were awfully effective.

I have lived in Delaware, and I was on the water committee in connection with that, and I think it's a technique that could be encouraged and expanded. Thank you again.

DR. SINGER: You made the point here in your statement that you feel some uses are incompatible with others. This implies that there will be situations of conflict between one use as against another possibly.

You also made the statement that local, state and federal agencies should work together, the governments should work together at various levels. I think we agree with this, certainly, but our recommendations to the Congress have to be quite specific.

Therefore, I wonder if you have thought about what level of government should be responsible for what.

MRS. MATHER: No, I don't. I personally do not, and I don't think our work in the League of Women Voters has been that specific. I think again, this takes perhaps more -- just as we can't recommend dissolved oxygen or coli, I don't think we have quite the knowledge from the studies we have done to signify which level of government.

DR. SINGER: I'm not speaking of technical questions here, but let me put it this way: Do you feel that local government is completely able to provide the proper conservation use and development of estuaries, or do you feel it must be done at the level of state government?

MRS. MATHER: Well, I think I could say that in general, probably local governments alone would not have the necessarily broadened viewpoint or understanding to do the job all by themselves, and in fact, maybe neither would a state completely, simply because many of these waters are not entirely within the jurisdiction of one state.

Therefore, we are back again to needing good communication and cooperation, and maybe eventually some new inter-governmental -- well, I can't think of a better word than an agency or some new device to work on some of these problems.

DR. SINGER: Thank you.

MR. TRAINA: What role do you see for a group such as the League -- and there are many other groups like this involved in water resources management -- specifically in estuaries?

MRS. MATHER: Well, I don't quite know. I think in some cases that role we have may be assumed as a sort of public conscience, and this is not always even a really pleasant role to have assumed -- pointing out what some of the problems are without being able to point out, as I have just been asked, what some of the solutions might be.

We have been conscientious, at least, in trying to keep up with what is going on and to see that the public is kept well informed in instances where they have not always been.

I think federal agencies themselves and the state agencies have been very good, but sometimes it has needed, in some areas, additional prodding to make the ordinary citizen aware that opportunities like this one today really exist.

Now, I know how hard the people setting this up did work to communicate with people, but maybe always this hasn't been so, and hopefully, some of the past prodding is reflected in the general concern for getting public opinion today.

MR. JENSEN: Mrs. Mather, I do have one question. You mentioned the public advisory committees which were established on the study of the Delaware. They were extremely effective.

They were very useful in many ways. We have not used them in this particular study for a variety of reasons.

MRS. MATHER: I realize that was an indepth study. I should think it might be very helpful to the various levels of government working to have a citizen-type advisory board.

You people are the ones who are working --

MR. JENSEN: I think our job here largely is to assemble many ideas and see if we can then make some suggestions to the Congress for an appropriate national program, and I use the word "national" and not "federal."

MR. THOMAN: Thank you again, Mrs. Mather. For the general benefit of the men here, I think you should know that Mrs. Mather's interest in the subject of water is of extreme long standing and she devotes a very, very considerable amount of time to this.

I hope I don't embarrass you by saying this, but I believe that you are one of the most enlightened members of the League of Women Voters in the United States on this general subject.

We will break for lunch in just a minute. I think it might be appropriate at this particular time to mention that there will be incorporated in the final record that is published a statement from the Resources Advisory Board of the Southeast River Basins, a statement from Mr. John M. Henderson, a consulting engineer of Savannah, Georgia; a reprint of an article from "Atlantic Monthly" Magazine by Mrs. Polly Redford entitled "Vanishing Tidelands," which her husband sent, who is State president of the Isaac Walton League of America; there will be a statement from the Garden Club of Georgia also incorporated into the record; there will be a statement submitted by the Southern Region of the YWCA; and a statement by the Petroleum Council of Georgia.

This morning we received a telegram from the Georgia Conservancy saying that they were unable to get an airplane off the ground this morning, so Mr. Hill could not be with us.

We also received a telegram from the Georgia Municipal Association, saying their statement will be forwarded.

There will also be a statement from the Council for the Preservation of Natural Areas of Georgia Mr. Robert Hanie, the Executive Director, was not able to get here today.

If we can be back at 1:30, I think we can be finished reasonably early this afternoon. We have approximately seven or eight additional statements to hear this afternoon.

(Whereupon the meeting recessed at 12:00 o'clock noon.)

THURSDAY AFTERNOON SESSION

February 29, 1968

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The public meeting directed toward obtaining contributions from Georgia interests regarding the National Estuarine Pollution Study, being conducted by the Federal Water Pollution Control Administration, convened in the Aquarama, Jekyll Island, Georgia, Thursday afternoon, February 29, 1968, and was called to order at 1:30 o'clock p.m. by Regional Director John R. Thoman, Southeast Region, Federal Water Pollution Control Administration.

MR. JOHN R. THOMAN: If everyone will please take his seat, we can begin. For the record, I would like to indicate that statements will be submitted for the record from the Isaac Walton League of America, represented by Mr. W. T. Underwood of the Atlanta Chapter and Mrs. Howard W. Nix of the Georgia Federation of Women's Clubs will also submit a statement for the record.

At this particular time, I would like to call on Mr. E. S. Bunkley.

MR. E. S. BUNKLEY: Mr. Chairman, ladies and gentlemen: When I signed that card, I put on there I was speaking for "Self." That wasn't exactly right.

There are a group of men, unorganized men, who just fish and hunt in this area. In conversations with them over a period of several months, we have been growling and griping about the conditions in this immediate area.

Now, when I say "the immediate area," I mean Glynn County, from the Altamaha River south to St. Andrew Sound. Over a period of ten years, from 1946 to 1956, I had a lot of time off at times and could do a lot of fishing, at which time I got to keep a log in a book showing where I went fishing, what kind of bait I used, the stage of the tide, stage of the moon, the wind, and if I caught anything, what it was -- all particular facts of fishing at that time.

I didn't have sense enough to realize what had happened, but in a five-year period, my log was all out of whack. Where I was supposed to catch fish, I wasn't catching them.

Well, I figured -- anyone fishing in tide waters knows fish move; they never stay put. Then I got to thinking about it -- there are a few people in this room who will remember this, that if we wanted a mess of fish, we could go down to the dock, get in a boat and go over to the jetties and catch all the sorts of fish.

Today you go over there, you catch catfish. Changes have been made. Now, what caused them? We men in Glynn County have our suspicions. We know that when we go out here in the river -- and three weeks ago this was reported to me -- when we go up the Turtle River to White Oak, come back and cross over Oglethorpe Bay, your boat needs a detergent bath to get the grease and oil off.

A man asked me what to do about it. I told him I thought it should be reported to the Coast Guard. Those are the conditions we are finding here in Glynn County.

I have many times pulled down to the Quarantine Station, which is a pile of rocks just off of the Lanier Bridge -- that's the bridge that separates Jekyll and Brunswick.

This afternoon as you cross the bridge, look over there, and you will see a pile of rocks sitting out there and a little island. That was a wonderful bass and whiting fishing spot.

There was a lay-up fleet pulled in there, and they very carelessly pumped bilges, and I haven't heard of any fish out there since.

When I was a boy, I kept a hand line at the mouth of the Plantation Creek, which is one of the creeks between Lanier Bridge and this Marsh Island Quarantine Station.

I always kept a hand line there, and I would catch some big croakers, drum, and pick up a bass now and then. That's certainly not the case today.

Now, there's been a lot of conversation here this morning, a tremendous amount of it over my head. This isn't exactly the type of meeting that I was requested to come to.

I was not requested by the officials. I was requested by friends of mine. A lot of this has been way over my head; the facts and the figures are all over my head.

All we folks want to know is what can be done and why can't it be done. Thank you.

MR. THOMAN: Thank you, Mr. Bunkley. We appreciate your statement.

MR. HOWARD: I would just like to tell you gentlemen that we recognize more than anybody else here today that we have got some real serious problems of pollution in our estuaries, including the Brunswick estuaries, but we are making progress in cleaning things up.

We actually need time to get with the problem and get it done.

MR. BUNKLEY: We realize that it is a big problem, that it took time for the area to get in the condition that it is and that it will take a comparatively longer time to correct it, unless a crash program is instituted to correct it.

MR. HOWARD: Thank you.

MR. THOMAN: I would like next to call on Mr. Bruce Dickerson, representing Hercules Incorporated. Mr. Dickerson has to catch a train rather early this afternoon, so we have moved him up on the program. Mr. Dickerson.

MR. BRUCE W. DICKERSON: Mr. Chairman, panel members, ladies and gentlemen: My name is Bruce W. Dickerson. I am employed by Hercules Incorporated of Wilmington, Delaware.

I am Manager of Environmental Engineering for Hercules Incorporated.

The program to be carried out by the Federal Water Pollution Control Administration under Public Law 89-753, 1966, "The Clean Waters Restoration Act," will provide a comprehensive picture of the character and quality of the estuaries of the United States and thus provide the basis for beneficial management of these resources.

It is our understanding that the hearing today will include both the Savannah River estuary and the Brunswick River and its multitude of backwater streams forming the estuary at Brunswick.

This network provides recreational use in all of its categories, supports fish and marine life propagation, handles navigation and serves as a receiver for treated municipal and industrial wastes.

Since Hercules Incorporated has major manufacturing facilities in each of these areas, we have a vital interest in this entire program, both on behalf of industry as well as our many employees.

Under the Federal Water Pollution Control Act of 1965, the states were required to classify and establish criteria relating to the quality to be achieved in both interstate and intrastate streams.

These were to be submitted to the Secretary of the Interior for his approval. In accordance with this legislation, the Georgia Water Quality Control Board, under the direction of Mr. Howard, Executive Secretary, developed the required information and held public hearings, ultimately establishing the uses and criteria.

These data were submitted to the Secretary and accepted, thus, in effect establishing these as federal standards.

The criteria adopted by the board were determined after serious consideration of all aspects of stream use, both present and future, and now form the basic standards by which industries and municipalities in Georgia are developing their management programs and timetables.

Many of these have now been accepted by the board and the necessary studies are being conducted to develop the ultimate facilities required for compliance.

The task outlined by the Congress under the Clean Waters Restoration Act of 1966, included the determination of the present state of pollution and the problems of pollution in the various estuaries.

The industrial and municipal programs now accepted by the state will not be fully completed before 1971. The final report on the estuary study must become complete by July 1, 1969.

Thus, the ultimate stream quality to be achieved will not be included in this federal survey. It is our considered opinion that there should be the utmost cooperation between the Federal Water Pollution Control Administration and the state board so that the recommendations developed by the Federal Water Pollution Control Administration will be in complete harmony with, and will supplement, the state programs.

Any serious departures will affect both industry and municipality and could cause untold problems both in consummation of approved programs, as well as heavy economic expense.

Such a condition would seriously delay the entire program and would be intolerable. However, we must stress that the Federal Water Pollution Control Administration should take advantage of the excellent work that has been accomplished by the state agencies and approved by the federal government and that final action must result in complete harmony between the two groups so that there will be no disruption of existing programs.

We appreciate this opportunity to express our views.

MR. HOWARD: Thank you very much, Mr. Dickerson.

MR. THOMAN: Thank you very much. Does anyone have any questions?

If not, I would next like to call on Mr. David H. G. Gould, Commissioner of the Atlantic States Marine Fisheries Commission. Mr. Gould is from Brunswick. Mr. Gould.

MR. DAVID H. G. GOULD: Gentlemen, I would like to mention the fact that I am one of the three Commissioners from Georgia. The Commissioner representing the seafood industry, Mr. Jack Cofer, President of Sea-Pak, was unable to be in town today.

The third position, which is the legislative position, is vacant at this time.

The Atlantic States Marine Fisheries Commission was established in 1942 by Congressional compact and enabling acts of the 15 contracting states for the purpose of promoting the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries, and by the prevention of the physical waste of the fisheries from any cause.

The importance of estuaries to the fishery resources of the Atlantic Coast is well documented. More than 5470 technical papers have been prepared since 1900, dealing with the ecology of the estuaries and coastal waters of the eastern United States.

Loss of estuarine production resulting from water pollution or the alteration of salt marshes which contribute to substantially to the complex food chain providing nutrients to the aquatic life in these areas is a major concern of this Commission.

The authors of a 1961 study concluded that Georgia's estuaries "are among the most productive natural ecosystems in the world."

The distance from Tybee Roads to St. Marys Entrance, the two extreme points on Georgia's coast, is only about 115 miles. Yet, within this relatively short coastline, Georgia has some 2344 miles of tidal shoreline.

This coastal area is characterized by marshes interlaced with a vast network of sounds, tidal rivers and creeks which are flushed twice daily by seven - to nine-foot tides.

These are situated between the mainland and a string of barrier islands and cover a total area of at least 520,000 acres, or an area more than half that of Rhode Island, and a larger estuarine area than in any other single state.

This estuarine complex of marshes and water area serves as nursery grounds for shrimp, crabs and fish, as well as the growing and harvesting area for oysters.

Studies at the University of Georgia Marine Institute have shown that the production of food for animals and man within these estuaries is approximately twice that of the best agricultural lands and is 20 times greater than the area of the open sea.

Without this remarkable estuarine area which provides food and protection for its abundant marine life, Georgia's prosperous commercial fisheries would wither and die.

The average wholesale value of fishery landings and manufactured products in Georgia is approximately 25 million dollars.

Some 57 manufacturing plants employing over 2000 persons in the processing and packaging of Georgia seafoods figure prominently in the overall value of the state's seafood industry.

The commercial landings of fish and shellfish at Georgia ports during 1965 and 20 million pounds, with a dockslide value of $4,100,000.

These catches included 8,589,000 pounds of shrimp; 10,215,000 pounds of blue crabs, 248,000 pounds of oyster meats, 350,000 pounds of roe shad, and approximately 300,000 pounds of edible fish, including king whiting, flounder, red snapper and sea bass.

Georgia outranks all other Atlantic coastal states in the production of shrimp, and its blue crab fishery is one of the largest on the Atlantic Coast.

The present rate of production of finfish and oysters is considerably less than the existing potential. In this regard, it has been noted that the Georgia coast is perhaps the most underdeveloped area in economic potential of the entire state.

Sport fishing interests are also significant within the vast estuarine areas of coastal Georgia.

According to a 1960 survey of hunting and fishing in Georgia, conducted by the U. S. Department of Commerce, approximately 167,000 persons participated in sport fishing on the Georgia coast.

This survey indicated an annual expenditure by salt-water anglers to be approximately $80 each for such items as bait, gasoline, boat rentals, guide service, et cetera.

On this basis, a conservative estimate of the coastal sport fishing activities can be placed at 13 million dollars, and the U. S. Senate Committee on National Water Resources has indicated that by 1980, such recreation requirements will increase by more than 60 percent of those of 1960.

Salt water sport fishing has been referred to as a growing giant. Georgia is doing its share towards proving the accuracy of this claim.

These conservative monetary values of this coast's commercial and sport fisheries fail to adequately present the full economic value of these resources or to give consideration to the importance of the aesthetic values of Georgia's beautiful estuarine areas which is the basis of a thriving tourist industry in the famous Golden Isles.

The welfare of these important fishery resources depends greatly upon a habitable estuarine environment. The value of the coastal area as an attraction to many thousands of tourists also depends upon its natural beauty and a high level of water quality.

Water pollution is perhaps the most serious threat to these resources at the present time and is in existence in far too many areas on the Georgia coast.

As an example, there are 74 areas and approximately 46,900 acres now closed to shellfish harvesting because of pollution. The economic loss due to these restricted areas has been estimated to be in excess of five million dollars.

The future presents many problems in light of expanding industrial and recreational use of these estuaries as well as an increase in the population of coastal cities and towns.

One use of these waters should not be at the expense of the other. Georgia's water quality control program and water quality standards indicate that significant progress toward attaining this objective is being made.

However, it is important to recognize that joint use incurs joint responsibilities, and that the cooperation of all who make use of these bountiful resources is imperative so that they may likewise be available for the use of future generations.

The Commission has published a statement of policy and guidelines for effective action on estuaries entitled, "Developing and Managing Estuaries." This statement is one of the most significant projects accomplished by the Commission in recent years.

A copy of this publication is included with my statement, and I would like for it to be made a part of the record of this meeting.

MR. THOMAN: It will be made a part of the record. Gentlemen, do you have any questions?

MR. ZELLER: I would like to explore this a little bit further. Would you elaborate on some other potential areas other than the landings that you mentioned?

MR. GOULD: I think it would be important, Howard, to point out that the values that are expressed are the basic values of the actual landings, and these were perhaps multiplied four to five times before they actually reached the market area.

An economic survey of Georgia's fishery industry is being conducted, and there will be a report, a complete report, out on that in the near future.

The potential of the commercial fishing industry, of course, is dependent, to a large degree, on improved water standards. One of the greatest potentials, I think, that we have on the Georgia coast in connection with our commercial fisheries is the oyster industry.

The Game and Fish Commission has been engaged in a joint program of oyster studies with the University of Georgia Marine Institute, and these are evaluation studies determining methods of improving the cultivation and production of oysters on the Georgia coast.

The restricted areas on the coast would be the sources of considerable deterrent to expanding the oyster industry. We feel that the shrimp industry is, of course, being utilized from the standpoint of fishing purposes at a very high level, but it's been noticed in recent years, not just for Georgia, but for the entire South Atlantic Coast, that there has been a decline in the landings of white shrimp where the catches naturally fluctuate depending on the spawning success of these one-year crop animals.

Over the years, there is an indication that these white shrimp are decreasing, and we feel that this is due to an increase of pollution along the coast of the South Atlantic states.

MR. ZELLER: This has been more or less of a gradual decrease?

MR. GOULD: Yes.

MR. ZELLER: I think you have a figure of 46,000 acres that are presently closed to oyster harvesting.

MR. GOULD: That's right

MR. ZELLER: If we could make a comparison, what percentage, would you say, in your offhand opinion, would this account for on the coast in terms of total area available for oyster harvesting?

A significant portion, or --

MR. GOULD: Well let's see. With the water area in our estuarine complex, it is probably about on a couple of hundred thousand acres, I would imagine; so this would be probably a fourth or perhaps a little bit larger percentage of the total area available for production.

MR. ZELLER: A significant portion, right?

MR. GOULD: Yes.

MR. HOWARD: I don't say this to minimize the problem existing in our estuaries in the Brunswick and Savannah areas, but I remember seeing a map one time from the Health Department which showed blackout areas -- of course, most of those were suspoded to have been closed because of total coliform count above seventy and so forth.

MR. GOULD: Yes, that's the standard --

MR. HOWARD: I think that everybody thinks now those are unrealistic criterion that they have for the oyster area, and I imagine if they had a real good magic number, we would probably open up a great many areas.

In Savannah, I saw a blackout area going up past the City Hall. I don't believe they ever had any oysters up that way. They probably have got five or six thousand acres that are closed that never had any oysters.

MR. GOULD: That may be true. I wouldn't discredit that point, but I think it is significant to point out the fact that there is a considerable area which was previously under production and being utilized by the oyster industry that is now closed to their use as a result of the pollution.

MR. HOWARD: Do you think that the criterion they use now for oysters is a good one, or --

MR. GOULD: Let me say this, I am no expert on biology, or health problems, or pollution or anything like that, but based on information and discussions that I have had with people who I do consider to be experts, I think that we probably could find a much better parameter for determining whether or not an area would be suitable for harvesting oysters than the present standards.

MR. HOWARD: Thank you.

DR. SINGER: I was concerned about the problem of whether this is a problem, whether one state doing something with its estuaries might affect the conditions in another state, take, for example, where fish migrate from one area out into the ocean and are caught in a number of successive states by fisheries -- could this become a problem, and if so --

MR. GOULD: Well, it is a problem.

DR. SINGER: Is it something that the federal government ought to take an interest in?

MR. GOULD: It's a problem that is being considered, and has been discussed and cussed in the Atlantic States Marine Fisheries Commission. We have a committee that is trying to come up with some uniformity or uniform management plans for the fishery resource, but this involves a lot of problems, local in nature, but, at the same time, rather insurmountable, that would be quite difficult to overcome.

But I want to point out that the matter is being considered and the committee has had scheduled meetings with people representing the industry and the various states on a local level to attempt to determine certain means by which this resource could be managed in a uniform sense, one idea being that one state perhaps has spawning areas, utilizes that particular species of fish at a different age level or under different age level or under different conditions than it does at another state.

The idea here is that the committee is going to attempt to bring about the best information that they can and to propose to the various states adoption of regulations for that particular fishery that would be in the best interest of that particular fishery resource.

DR. SINGER: Do you feel if the states adopt these recommendations that the problem would be adequately handled?

MR. GOULD: I think this would be the best approach to handling them.

MR. TRAINA: Mr. Gould, we heard this morning some of the problems relating to the legal aspects of ownership of coastal areas. Has this caused a lack of development of Georgia's potential for seafood harvesting?

MR. GOULD: There is no question that it's been a hampering matter. In Georgia, your greatest producing areas are subject to, and in many cases are, privately owned.

However, I know of one oyster fisherman who has a very good oyster program who has been able to obtain the oyster rights to a number of tracts that are privately owned, and he is utilizing them in a very progressive cultivation practice on oysters and has been very successful.

MR. TRAINA: Has your Commission looked into this? Do they have any suggestions on possible local regulation or state law?

MR. GOULD: The Atlantic States Marine Fisheries Commission considered regulations just a few years ago concerning some uniformity in laws pertaining to the various activities in estuarine areas, such as dredging and filling projects.

So each of the member states got together the various laws that affected these activities within their own states and forwarded them in to the Commission office in Tallahassee.

They were then forwarded on up to Virginia, to Milton Hickman, who happens to be the Fisheries Administrator in Virginia and also a lawyer by trade, and these were so complex and, in many instances, so conflicting that I think we quite suddenly realized that obtaining uniformity in these laws along the entire stretch of the Atlantic Coast at the present time is impossible -- not impossible, but would require a very long-range, extensive program to work into all the legal technicalities and difficulties that would be involved.

MR. TRAINA: Do you think it is worth exploring by somebody?

MR. GOULD: Well, I think so, yes, but there shouldn't be any hurry to come up with answers, if they do. There are a lot of old King grants that are being contested.

There are even titles in Georgia in many instances to the marshland areas that are very difficult to ascertain, and I think it would be a very complex situation to resolve, but certainly it's one that we shouldn't give up on.

MR. TRAINA: I'm not a lawyer, but I understand lawyers like complex situations.

MR. HOWARD: Confusing, confusing, confusing. David, I would like to ask you two questions right quickly. About how many commercial operations are there between Brunswick and Savannah, would you say, that have got commercial shellfish harvesting going on?

MR. GOULD: You mean individually?

MR. HOWARD: Yes, just an estimate of how many are going on.

MR. GOULD: Probably in excess of a dozen.

MR. HOWARD: We do have about that many left then?

MR. GOULD: That's right. Most of them are on a small scale. I would say that perhaps -- you could count on the fingers of one hand the ones that account for the greatest majority of oysters.

MR. HOWARD: Let me ask you one other question. It's your opinion that probably the best thing we could do in the State of Georgia is to concentrate on cleaning up existing pollution and preventing additional pollution to our estuaries, or should we get off on a tangent and start passing more laws at a federal level and so forth?

MR. GOULD: Well, I think I indicated in my statement that we felt like -- at least I personally feel like -- the present program that we have here in Georgia is very good and that I feel the water quality standards that Georgia has adopted are very, very progressive and very adequate.

But I would say this, that we perhaps need to spend more money on our water control program than we are at the present time, and I think we need to get more personnel.

MR. HOWARD: I told the Senate that the other day.

MR. GOULD: I feel that is the most important thing at the present time insofar as our fish resources are concerned.

MR. THOMAN: Thank you. I would next like to call on Mr. Lewis Todd.

MR. HOWARD: Mr. Todd was here a while ago and told me he had to go back for some reason or another.

MR. CHARLES M. FRISBIE: My name is Charles Frisbie, and I am with the State Game and Fish Commission of Georgia. Mr. Todd was called home a while ago and of course couldn't make it this afternoon because of his health.

MR. HOWARD: I don't understand why, but he said he had to go.

MR. FRISBIE: His statement reads as follows:

"I derive my livelihood from commercial fishing: shrimp, oysters, crabs, finfish, et cetera. My main efforts in the commercial fishing industry are concentrated in the Doboy-Sapelo Sound areas.

"I have been involved with the oyster industry for the past six years. Two years ago, in cooperation with the University of Georgia. on Sapelo Island, I transplanted between 7500 and 8000 bushels of oysters to unpolluted waters in an effort to restore the oyster supply.

"I have expended considerable time, effort and money in attempting to rebuild and develop my oyster grounds that I have under lease.

"I have recently constructed a storage locker and shucking house, which I plan to open next season.

"During the past five years, my ultimate objective in managing my oyster grounds, by replanting shell and transplanting shell stock, has been to provide an adequate supply of oysters for my shucking house as well as my current business of selling them in the shell.

"When I became involved in the oyster industry, I received assurance from officials in the State Health Agency that the areas wherein I planned to work where not polluted at that time, and, barring the establishment of some large industry in this vivinity, the waters would remain as such. Based on this, I obtained long-term leases at considerable expense.

"In addition to my involvement in the oyster industry, I own two shrimp boats. My annual gross income from these two boats, from shrimp fishing alone, is between $40,000 and $50,000.

"I derive my livelihood for me and my family from the estuaries of Georgia. Pollution of these estuaries would destroy my source of livelihood.

"I endorse the water use classifications and water quality standards set by the State Water Quality Control Board and approved by the Federal Water Pollution Control Agency.

"I urge that these standards be strictly enforced to insure the continued existence of my business enterprise, as well as those of the other thousands of people in Georgia involved in this industry.

"Respectfully submitted, Todd's Oysters, Shrimp, Fish and Crabs, Lewis Todd, Owner."

MR. THOMAN: Thank you very much, Mr. Frisbie. Next I would like to call on Dr. Henry, the Director of the University of Georgia Marine Institute at Sapelo Island.

DR. VERNON J. HENRY JR.: Thank you. I would like to supplement Dr. Odum's remarks with a brief statement that more specifically relates to the Georgia Marine Institute and its vested interests in clean water.

First, a little history, I think, would be advisable. The University of Georgia Marine Institute was founded in 1954, though the generosity of the late Richard J. Reynolds, who, as President of the Sapelo Island Research Foundation, provided the facilities and a portion of the operating funds which enabled the University of Georgia to establish a marine laboratory at Sapelo Island.

The Sapelo Island Research Foundation continues in their support of the university's operation and the balance of the funding is provided by the University of Georgia and various federal agencies.

From an original staff of two resident scientists, the Marine Institute has grown to have a complement of 15 full-time resident scientists, 11 of whom hold the Ph.D. Degree.

Our annual budget is approximately $350,000. From its initial role as a marine biology field station, the University of Georgia Marine Institute has become a multidisciplinary laboratory investigating basic biological, physical and chemical aspects of the estuarine and shallow marine environment.

In addition, the laboratory functions as a field station for visiting investigators from the university, as well as other institutions; for students working on advance degrees in marine sciences; as a training area for class groups from other institutions, as well as our own; and as a center for research in estuarine aquaculture.

The ultimate goal of the Marine Institute is to approach a total understanding of the interrelationship among the estuarine plants and animals and their environment -- in a word, their ecology -- and to translate this knowledge for use in areas of public need.

Mr. Chairman, the reason for the presentation of this background information is to point out that the University of Georgia Marine Institute has developed into a facility of state and national prominence primarily because of the unspoiled natural habitat to which it offers access. We have a vested interest in pollution abatement.

I would like, at this time, Mr. Chairman, to make several brief statements concerning initial steps that I feel should be taken toward effecting pollution control and abatement.

Approximately 50 percent of the estuarine waters of Georgia are closed to commercial shellfishing principally due to sewage pollution.

It is important to keep in mind that coastal Georgia has, in most areas, a very low population density, and that as the population increases, so will the potential for further pollution of this type.

Therefore, I strongly support the grants-in-aid to municipalities for treatment plant projects, even in the face of budget cuts in other categories including research.

The Estuarine Area Bill HR-25 by Representative John Dingell, and the amendment presented in his memorandum of February 7, 1968, should be adopted, thus providing the means, not only to study and inventory the estuarine environments, but to acquire strategic lands and waters that should be maintained at desired levels of naturalness.

Strict enforcement of the water quality standards as set forth by the Georgia Water Quality Control Board is urged as a first -- and perhaps most important -- step in pollution abatement.

In order to provide the additional personnel and activities needed for monitoring water quality standards, the Georgia Water Quality Control Board should be funded at a considerably higher level.

Hopefully with federal, as well as state, funds, should this be done. Mr. R. S. Howard and the board are to be commended for efficiently carrying out their difficult tasks.

The Clean Water Restoration Act of 1966, PL89-753, identifies two physical areas -- namely, river basins and estuarine zones -- which are delt with under Titles I and II of the Act, respectively.

It is hoped that this division was done initially only to better plan future programs of pollution control and abatement, and that this artificial separation will not be permanently fixed.

An estuary in itself is difficult to define. Where an estuary stops and a river begins is equally difficult to define.

In setting up future regions for pollution control and study, it is strongly urged that the river basin and estuary be treated as a single unit of the natural environment, similar, in fact, to the basin description outlined in the Southeast River Basin Study of 1963.

MR. THOMAN: Thank you. I have one question to ask you. If you have got a certain area that belongs to you or is under your control, what level of research, dollar-wise, would you consider adequate --- what could you do in this particular area?

DR. HENRY: Of course, that depends on our goals.

MR. THOMAN: I know. But you're spending $350.000 a year now. Is it a million dollars, 50 million dollars, or is it where you are now? What are we talking about in needs and requirements?

DR. HENRY: Well, first, let me answer that from my own interest area. I think Dr. Odum certainly was correct when he advocated the formation of model studies which would necessarily be done in rather isolated areas, such as Sapelo Island, because they have to be in the environment that is to be studied.

This, of course, creates additional costs, because of the isolation. So one answer to your question might be depending on where you are carrying out your operation.

Of the $350,000 of our budget, a considerable portion of that goes into operational costs.

MR. THOMAN: This is what we want to know. The reason I ask this is that in our own work, as long as we work on fresh water, we can pretty accurately estimate the cost of doing a study or survey.

But as we have moved more on down in the brackish-water areas, we have found that our costs are just about double of what they are in fresh water.

DR. HENRY: I think you are talking about a million-dollar level of research. Of course, I think any time you move into salt water from fresh-water areas, you double the cost, even when we are using the same product.

I don't know why this is. It's like vitamin pills and everything else. We do have a difficult time with the tremendous cost of scientific equipment.

Sometimes you can buy the same article in the local supermarket that is a reasonable price, but three or four times the cost in a scientific catalog.

So this type of research is quite expensive.

MR. THOMAN: Thank you.

I would next like to call on Dr. Tom Linton, who is with the University of Georgia.

MR. HOWARD: He is a refuge of the Sapelo Island group.

DR. THOMAS L. LINTON: I am with the University of Georgia Marine campus, and the statement that I am to make today, or will present to you today, will be a consensus statement from the University of Georgia, including the various disciplines, scientific disciplines and technological skill groups that we have in the university.

I have spent five happy years at Sapelo, and I am a marsh rat at heart. We have in the university a variety of discipline and technological skills, and the spectrum included here goes from the basic research interests through the management of fisheries and wildlife, and for industry, interests in mining, community planning and area development, the legal aspects of the salt marsh estuarine complex to the economic consideration of the salt marsh estuary.

We will have a prepared statement to submit at a later time within the time period allowed. At the present time, I would like to give you a brief summary, and this will be about a 20-page statement, so I am sure that you will be more than delighted that I only have about five minutes of comments.

The estuary at the present time receives here in Georgia many oxygen demanding materials, which makes it unfit for the nursery purpose that it usually serves for shellfish and shrimp and things of this sort.

But we have a pollution problem today that exists in Georgia. It is serious, and it is of concern to us at the university. We at the university support the Water Control Board.

We endorse their approach of a statewide monitoring system to recognize potential problems. By having a statewide monitoring program, we will have the opportunity, to be able to correct these perhaps before they do arise.

We fully endorse secondary treatment of wastes. My primary concern is the fishing industry in Georgia. I can't help showing my bias here, and as Dr. Odum has mentioned, our shrimp industry is worth approximately five million dollars at the dockside, and the crab industry, about two million dollars, and the crab industry in Georgia is only at best half developed.

If we had advances in technological skills for better and more economic harvesting of crabs, our crab industry could be at least doubled. We have about a half-a-million-dollar oyster industry. We have about a one-million, or one-and-a-half-million-dollar shad industry.

And we have in the neighborhood of a million-dollar menhaden industry. But we really can't get accurate figures on this, because boats come from the Carolinas, from Florida and catch shad or menhaden off our coast and return them to their home state, so we do have a renewable resource here.

We have the deposits of phosphate underneath the marshes in this area. It's not economically feasible to mine these things at the present time, but probably in the future it will be mined.

We also have the possibility of petroleum existing under our marshes. If these are to be used in the future, it is our responsibility to use them or excavate them in such a way that the marshes will not be permanently destroyed or permanently lost, because it is of importance to a wide array of people.

It is something that belongs to the citizens of Georgia as a whole.

We could possibly increase our oyster production by forty-fold since we know that in the past 50 years there has been a forty-fold decrease in oyster production.

By aquaculture, we can increase our seafood production. We are in a position where we can do this. Our research activities in the university relate to these problems.

We also are involved in a legal aspect. We are interested in determining who owns the marshes. This is something we discussed while Mr. Zeller was with the State Fish and Game Commission -- inventory to find out exactly who owns the marsh lands.

These are things that could be handled in the broad umbrella that covers a great number of disciplines and interests in the university.

At our university, in addition to a large staff of biologists working directly on the physiology, if you will, of the marsh, the university has a community of other institutes, departments and specialists who are working and thinking about all of the aspects and problems that are associated, such as the social, legal and economic implications in estuaries.

Perhaps chiefly among these would be the newly formed Natural Resources Institute, which represents the university's general concern for the wise use and protection of the marshes.

I have noticed the definite lack of suggestions for solutions to problems in all of the presentations that we have had today. The University of Georgia has in its boundaries a wide group of people who are familiar with all these various disciplines that I have mentioned to you.

We have a tremendous amount of laws, I think, governing the use of the marshes we have. We have a water control use criteria. We need to get people, the general public, to support these, and we need to enforce them.

And if we get every citizen in Georgia aware and in support of these laws and governing criteria, then the enforcement problem will not be as great as if we have a few people we get together down on the coast to talk about the problem.

But if the people of the state as a whole are aware of this and realize that they have a stock in the estuarine area as part of the heritage that they will pass on to future generations, then our enforcement problems will not be as great.

We in the university extend an open invitation to all municipalities, industries, private citizens and groups who are concerned with the use or misuse, or recreation values, or whatever, of the salt marsh and the estuarine area, to cooperate in trying to solve these problems, and seeking solutions to them, and wisely manage this valuable and unique resource that we have.

In conclusion, I would like to say that Georgia has more salt marshes and estuaries per mile of coastline than any other state. At present, tremendous marshes and estuaries of Georgia are relatively unspoiled.

When you look at the East Coast as a whole, Georgia is a relatively unspoiled area. This area contrasts markedly with those of other states along our East Coast.

We have studies set up at the university to determine the effectiveness of recycling paper mill effluents through forest areas to reclaim the water so it will not be as detrimental in its reentry.

We have a four-and-a-half-million-dollar study that is going on at the university to try to determine the effects of the influence of the established paper mill in an estuarine area.

We have a proposed study in the institute of law and government which deals specifically and will deal specifically with the legal aspects of estuarine law.

We have economic studies on the way to determine the economic influence or the economic impact for estuaries and the estuarine areas on the economy of the coastal area and the state as a whole.

I want, once again, for the university to extend our invitation to cooperate and work together.

Shortly before I was married, an old friend of mine took me and said, "In order to make this marriage work, you soon must realize that marriage is a give-and-take proposition. You do all the giving, and your wife does all the taking."

Fortunately, my marriage didn't turn out to be like that, and I hope that we will not have an all give-and-take situation, but rather, work on a 50-50 basis. Thank you.

DR. BURBANCK: I want to speak more in general about the amount of moneys involved here, and it seems like it's now between 20 and 25 million dollars per year in various aspects of fisheries and about that amount in the other aspects of recreation and so forth.

So would you say, then, that if we considered this like a return on an investmenc, say five percent, which is the going amount in this stage, that we have got, then, about a billion-dollar capital?

DR. LINTON: Yes.

DR. BURBANCK: If I figured this out right, five percent of a billion dollars is about 500 million, and would this be a correct estimate of the situation?

DR. LINTON: That is the figure that I arrived at once, projecting these as a five-percent return or five-and-a-half-percent return.

Just go out and take the natural situation and a billion dollars -- you're in the right ball park when you're talking about that over an extended period of time.

This is a renewable resource that keeps coming back to us and back to us. You're a little low on the recreational value here. It's about three times that of the commercial fishing aspect, I would say.

I think we could substantiate this with some studies that have been done in this area.

MR. HOWARD: From what you have said about your longing to be in the marshes and all, I guess there is also a spiritual value from all the beautiful marshes, right?

DR. LINTON: Right. I gave a talk at LSU once, and my brother came -- it was the first time he had been around to hear any of my elaborate speeches -- and I mentioned the aesthetic qualities of the marsh.

Well, he said, "That's not true."

But I told him, "If you're a swamp rat who swamps around there and enjoys it, there's an aesthetic quality that you can't put a dollar value on. It's nice to come back and smell the swamp."

MR. HOWARD: Right.

MR. THOMAN: Thank you. At this time, I would like to introduce a late arrival to our group. Hopefully, he was solving a legal problem this morning, and I don't know whether he did or not, but I would like to introduce to you Mr. Murray Stein, Federal Water Pollution Control Administration.

I think he is known to some of the audience here. I just wanted to introduce him to the rest. He used to be the big bad man of the federal pollution control effort, and he is sort of reduced from that stature at the present time.

MR. HOWARD: He has mellowed a lot.

MR. THOMAN: Glad to have you here, Murray.

Next I would like to call on Dr. A. M. Herrick. He is from the University of Georgia. Dr. Herrick.

DR. A. M. HERRICK: Jack, I do not believe I am going to make a statement at this time. I do appreciate the invitation. However, since you have so graciously called on me, I would like to point out that by action of the Board of Regents last month, I believe at their meeting on the 11th and 12th, we are now a School of Forest Resources.

This may be attested to, perhaps, by the fact that I am flanked, not only including Dr. Odum, but by an individual interested in outdoor recreation, another man interested in forest hydrology, and you just heard from Tom Linton, who is a member of my staff.

MR. THOMAN: Thank you, Dean Herrick. Next I would like to call on Gordon Singletary from the Brunswick Pulp and Paper Company. Mr. Singletary.

MR. GORDON K. SINGLETARY: My name is Gordon K. Singletary. I am a Senior Vice-President and General Manager of the Brunswick Pulp and Paper Company.

Our mill manufactures high-quality pulp and paperboard products. We are located on Turtle River just north of the Brunswick city limits.

Since we are a substantial user of water for the production of our product and depend upon the deep navigational channels for transportation of raw materials and manufactured goods, we are vitally concerned with the continued supply and quality of this natural resource.

We compliment you on this study program for estuarine waters, and we offer our cooperation and support in helping you achieve the objectives outlined in your National Estuarine Pollution Study Manual, dated July, 1967.

We concur with the assumption that the technical aspects for pollution control in estuarine areas are infinitely more complicated than in freshwater areas.

My company has certainly found this to be true during its 30 years of experience on the Turtle River.

We believe that emphasis by the federal government at this time should be upon the establishment of research and study projects to obtain additional factual information on marine ecology and physical characteristics of estuaries.

We hasten to point out, of course, that such research and study must consider multiple use as an essential concept. This is, in our opinion, in the best interest of all the people.

We need only look at our own Glynn County area to see that this is a practical way to make the best use of our waters. Our estuary now successfully supports recreation, both in the form of swimming and fishing, commercial fishing, navigation and industry.

As you may know, my company has worked quite closely with the Georgia Water Quality Control Board and its Executive Secretary, Mr. R. S. Howard. We are confident that the Georgia law and its administration is completely adequate to protect and maximize the use of all the waters of the state, including coastal waters.

The data obtained from the Estuarine Study will prove valuable as a supplement to the state's current program. Additional information can only result in more effective water management programs, and to this end we cast our support.

MR. THOMAN: Thank you, Mr. Singletary. Do you have any questions, gentlemen?

MR. HOWARD: Did I understand you to say our Brunswick area supports such uses as swimming and bathing?

MR. SINGLETARY: Yes, I did.

MR. HOWARD: The "Atlanta Journal" had an article last Sunday that said it did not.

MR. SINGLETARY: Well, I don't want to get into it, but that is not true.

MR. HOWARD: They tell me they got that from some of these experts that --

MR. SINGLETARY: Not being an expert, I couldn't get into an argument on that.

MR. HOWARD: Thank you, Mr. Singletary. Don't forget, we will accept grants.

MR. THOMAN: Mr. Verross would like to give a short statement what his company is doing in the Riceboro area, and he is now speaking as the general manager of Interstate Paper Company, a subsidiary of Interstate Container Corporation.

MR. HOWARD: Be sure you tell the background information on this.

MR. WILLIAM J. VERROSS: I find it a bit embarassing standing here now, having recently made a statement, that more research is needed. I think that to someone who spent 19 years in the estuarine ecology research; that someone else has read of or knows of thousands of papers published and certainly in reading the puslished statements of certain people with no particular ax to grind - that it does appear that there is a tremendous amount of research that has been done on the estuaries in the United States.

Our problem at Interstate, when we received a permit to build a mill in Liberty County was compounded by the fact that most of this research that has been done tells us, or told us, what couldn't be done.

I think, if you will analyze the results that the various people engaged in research have reported here today, you will find the results are essentially what will damage an estuary.

By inference, we then should assume that if there is no data relative to a particular thing damaging an estuary, we could then assume that the other materials don't damage it; but despite all the research carried on up to date, we found that was not really a conclusion that the marine scientists were willing to draw, nor are they willing to draw today.

Now, I don't run scientists down when I say that. We came in with the full intentions of using the available research, the research available at the time, to design a plant and a treatment facility that would, in effect, prove that industrial, recreational and other aesthetic uses were both possible and practical.

Now, when I ask as an individual for you to do more research, I'm saying, do more research in finding out what can be done with an estuary, rather than what can't be done with an estuary.

I have been making paper for 21 years. I say the information we need from the scientists is not what can't be done, but what can be done. We hear in our contracts with the scientists, the marine biologists, we think that something will happen.

We sort of guess that it will, but we don't know. Well, to a man who is trying to set the design on a treatment plant, to the man in a city government trying to decide on just what he has to provide in his treatment plant in order for the bond issue to pass -- I could go on with examples of this -- the man needs information of what the estuary can do, not what it can't.

I liken the problem that you marine biologists have to a statement made once that the simplest way to cut down the accident rate in the United States is to reduce the speed limit to zero and then enforce it.

We would have no problems with the estuaries, I guess, if we put them all back to the way they were when the Indians were here. Unfortunately, as Tom Linton says, we can't do that.

The other problem that our marine biologists ran into in our contracts with them, setting up our particular program, the Marine Institute, is that unfortunately, there isn't anyone who can talk to the fish.

If we had one man in this country who could stick his face down in the water and say, "Hey, Fish, where were you born? Hey, Mr. Fish, come over here. I'm putting some stuff in here. Tell me if you like the taste of it."

We can't communicate with these things that we are so concerned with, and you would be surprised, as I was, in talking to these marine biologists as to how much they have to infer.

You find there are a great many things that are done by inference that I'm saying that we need to have done by research to take the inferences out of it.

I think that the federal government role in this, and I, and on behalf of Interstate, who is sponsoring a research grant through the Georgia Water Board with the Marine Institute, we urge that this be done by a government agency for a very specific reason -- the results will be believed by the legislator.

I think that industry has probably spent as much or more than government agencies on research. The trouble is, when the time comes for that material to be used in the course of bringing about regulations or legislation, it is automatically suspected -- when we chose to put the grant with the Goergia Water Board and with the Marine Institute, we were depending on objective scientific results and conclusions.

I am happy to state, in our opinion as a company, we are getting that. Now, that's a credit, I suppose, to Dr. Herrick and Tom Linton, to pass out a few kudos here.

We didn't know who they were. We didn't know at the time we made the grant whether we would get objective results or whether we would get biased results.

I think that Tome Linton would probably admit that he was pretty biased, but now I am happy to report that Tom Linton is an objective scientist from my contacts with him.

I think there are a great many more objective scientists in the various state and federal agencies. If they will remain objective and draw their conclusions from the data they have, rather than the preconceived notions that someone gave them to start out with, we can prove that multiple uses probably are desirable and practical.

MR. THOMAN: Thank you very much.

MR. FRED MARLAND: Mr. Verross, can you tell me how many gallons of water you plan to use at your plant in April?

MR. VERROSS: Five million gallons a day.

MR. HOWARD: Would you mind telling what degree of treatment was imposed on you --

MR. VERROSS: There aren't too many of them going to die here of shock if I tell them. For a four hundred tons a day plant, we are limited to 800 pounds a day of BOD in the North Newport River.

I am the only guy in the room and Charlie Davis, here, who aren't really overworried about it. It is possible - it's going to cost us money. It's going to cost us more money than any other paper mill here in the Georgia area.

We had an advantage knowing that in the start; that we did put in certain design features. That is a mighty low load on the North Newport River.

I may a month from now stand up in the same room and eat my words and say it can't be done, but at least in conjunction with the work we did with the Water Board, we have at least accepted such a restriction, because we don't want to kill the fish either.

DR. LINTON: You consider this to be a cost of doing business. Would it not be less expensive in the long run than trying to clean up the mess after the --

MR. VERROSS: Well, to us, it's a cost of doing business, because the Interstate Container Corporation, in accepting all the conditions here, this was done, by the way, before I came with them.

They said, "Are you willing to work within this framework?"

And I accepted it right from the start. You might say I negotiated with a gun at my head, because I honestly believe it can be done, Tom, and the answer is Yes, it can be done, providing our customers, Interstate's customers, will pay for it, because they will accept or reject this, whatever the cost comes out in terms of price we have to charge for our product.

If, in fact, our customers will not pay it, they will, in effect, vote for some other method, and I can't answer now what it is. Yes, there is going to be a cost.

It may be the difference in a competitive advantage, or again, it may not.

DR. BURBANCK: I would like to two comments. First, I think you did exactly the right thing to have a group of ecologists work with an area where you were going to be.

Now, I don't know about the 4000 reference bit, but I think that was probably Bob Cunningham that cited that, but which included estuaries all over the world.

But if I were to ask you if a pulp company up in Maine used the exact methods that a pulp company did in Louisiana, I would be a little bit surprised, and if I were to try to give you information on it, it wouldn't be the same for the two classes.

MR. VERROSS: If I may interrupt -- precisely, but if you're going to base legislation on the on the control of an estuary, what data will you use?

DR. BURBANCK: You need to use it from where it's been gathered.

MR. VERROSS: This is my point, exactly. The information is needed, the research is needed, in order to make effective regulations and legislation. You don't base legislation on what happened to oysters in, say, Virginia, for oysters in Georgia.

DR. BURBANCK: I think the only place I would differ with you is because of this information gap. In some places all we ask for is a holding action until that can be gotten.

Now, I realize that the pressure is on when people who sell stock and people who want dividends say to get going right away. They say, "What are you doing with our money?"

And this is the part that you labor with, but in a lot of cases. we just do not have the information, and wouldn't it be better to say, "I think," or "Maybe," than to say, "It is so"?

And we don't know that it is so.

MR. VERROSS: Quite. I would rather you say, "I think" than "I know."

DR. BURBANCK: That's right, but this is the objection. Now, in England, the limnologist has the same status as a physician, and his testimony stands in court on the basis of "I think," because this is his practical judgment. We don't have that here yet, but we may.

MR. HOWARD: We probably do have it, because we get so many confusing answers from some of our biologists.

MR. THOMAN: Thank you. Is there anyone whose name I did not have on my list who cares to say anything?

MR. DAVID S. MANEY: Yes, I have a statement.

MR. THOMAN: Would you please come up here.

MR. MANEY: I am David Maney, the Executive Director of the Coastal Area Planning and Development Commission. I have listened with interest to this, and I am not a professional from the standpoint of the ecology of the area and the estuary usage, but I have a deep interest, and I want to tell you that we welcome you here in the Golden Isles, which covers the coast of Georgia.

It's been my privilege to listen to the proceedings. Dr. Odum has described our feelings here very well. We have an agency that is outstanding, headed up by Mr. "Rock" Howard, and we look to them for our assistance and help. I might tell you a little bit about the Commission we have. It is a regional planning commission composed of six counties.

It has 25 commissioned members. These counties are Camden, Glynn, McIntosh, Liberty, Long and Bryan. I will explain a little bit more of our operation, if you desire.

The heart of our planning district is in the estuaries in the fact that we have water and the fact that we have a common interest throughout the coast of Georgia.

We are a support group for development as well as for preservation programs. The estuaries -- I'm directing my remarks primarily to those, because we have many other fields with usage in our area -- the estuaries, I would say, are our primary industry in the light of aesthetics, scientific value, and fishing and other things that have been said here, and they must be treated with gentle loving care.

We have recreation, and we are striving to encourage this up and down the coast by asking the state to help us, and that the federal government create fishing reefs.

The Fish and Wildlife Department is helping with fishing drops in our areas. Sport fishing is a big industry. We also have opened an open-space program which is a responsibility of all our areas here to see that there is such a thing as to be called open space.

Proper land-use development is essential. We are just now starting a program, and it is a federally funded program called "comprehensive areawide health planning."

Our office will be the base for this study. This study will be of the 20 counties in this area. I might interject, we had two other area commissioners represented here today that could not stay for this afternoon's session.

We had an Altamaha five-county area planning and development commission director here, and we also had the Georgia Southern Area Planning and Development Commission director here.

I wish they could have stayed, because I hate to interject my thoughts alone on this, because they all are interested in this particular program.

One phase of this comprehensive health planning is water pollution, and it will encompass all aspects of health dealing with our environment.

I have a summary of what this study will be, and I will read that a little later on. Another program that we are carrying on is an EDA program, Economic Development Administration program.

We have been designated as an economic development district and are being funded for industrial development for all types of development, which includes recreation and any other assets that we might be able to promote to up the economy of our area and to help the unemployed and so on.

We are involved in a Farm - Home Administration program, a water and sewer program for small rural communities. We work with many organizations, such as the Georgia Conservancy -- the Department of Interior has been here -- for the last three or four days, we have been having a similar meeting with the Department of the Interior.

The Fish and Game Department has been a great help to us, as has many other organizations. In our area, rivers immediately involved are the St. Marys, the Satilla, the Turtle River, the Altamaha, the North and South Newport, Ogeechee, and we also have an area that is not designated as a river, but it would be called the inland waterway which bisects our area from top to bottom and is in great use.

We have certain peculiar problems that we, as planners, are concerned with: proper development of the island, river development, along with our transportation and highway -- Cumberland Island National Seashore Park, I hope, someday will become in existence with the estuaries included.

There are other uses which were explained earlier for the island development research. Privately owned activity, one of the things that we have used -- I am not making an announcement of this -- the Georgia Natural Areas Council, headed by Bob Hanie, has been acquiring access to 3500 acres of marshland for research study, which is a great step, and I hope more will come along this line.

Our Commission and members of the Commission, the staff, look forward to the study and offer our cooperation and assistance. In our six-county area, we have the estuaries, and they have been there since time, and many times we are that close, and we neglect to realize the importance of them in our counties.

I feel that times have changed and our pace has quickened, and we have to look back and stop and go into this type of study. I want to read this one summary of the comprehensive health area study, because it doesn't deal with hospitals, doctors and other things; it deals with a lot more than that.

I would like to pick a couple of excerpts from this. It says, "This study should be concerned not only with the mental and medical health needs of an area, but more basically, it should be concerned with the conducting of studies of what actually comprises good health, what steps can be taken to strengthen the area's weaknesses.

"The study should concentrate on a full range of the health-determining factors of the area. This must include the studies of problems of air, water pollution, availability of fresh and wholesome food-stuffs, adequate recreation facilities and creative activities, since it should ask itself how the environment affects the moral and spiritual climate of the area.

"Does it depreciate areas of housing, or does landscape contribute to the moral imbalance of an individual and in turn affect his physical balance?"

"It cannot be overemphasized that the study should be conducted on as broad a base as possible and should, of necessity, encompass physiological, as well as the psychological needs of the area.

"A healthy area is healthy only so long as it satisfies the needs of the mind and the spirit, as well as the body."

That is encompassing a lot. It's broad. It's general. I think it tells a little bit about the operation of what we are trying to do as an area planning commission.

I thank you for this opportunity.

DR. SINGER: I believe there was mention that this Commission was set up by a state law by the State Legislature.

MR. MANEY: Yes, that's right. I have a copy of --

MR. THOMAN: And here's a map of the area.

DR. SINGER: How was it supported? Can you tell us where your operating funds come from?

MR. MANEY: The County Commissioner got into that this morning a little bit. Based on the 1960 census, 25 cents per capita has been the general standard.

In some areas it's a little bit more and in other it's a little bit less. These counties have chosen of their free will, by an act of their County Commissioners, and City Councilmen and by resolutions, to become a member of this Regional Planning Commission.

This money is then on a two-to-one matching fund by the State Legislature, who have appropriated money to our operation for the first $15,000 and one-to-one matching funds for every dollar collected above the $15,000.

That gives us a base to work from. My particular Commission -- since I have been with this Commission, which has been a little over a year -- has increased our budget in terms of grants from many different programs, and probably within the next year we will be reaching close to $200,000 as an operating budget.

At the present time, we are operating on about a $120,000 budget.

DR. SINGER: I am trying to understand if you operate in a manner, let's say, to the Bay Development Commission in California. Do you carry on construction proposals, modification proposals, that come in connection with estuaries?

Would they be referred to this Commission to see whether they are in accord with some plan that you're developing?

MR. MANEY: Yes.

DR. SINGER: Supposing some major dredging were to be done in one of the estuaries here, would this Commission enter into this operation at all?

MR. MANEY: If we knew about it, we would interject ourselves into it as an advisory board. We, through time, will be asked to be consulted. Most all state agencies do this now, as do private agencies.

Today Georgia Power is here to deal with us on helping out with this new plant on the Altamaha.

MR. THOMAN: But you have no enforcing authority?

MR. MANEY: No, the only enforcing authority that a Planning Commission has is through the local legislators, the local government body, which is the county.

Now, in our particular Commission -- I'll give you the makeup of it briefly. The chairman of the County Commission of each of the counties is a member of our Commission.

The Mayor of the county seat is also a member of our Commission in addition to interested citizens that have been appointed, civic-minded people.

MR. THOMAN: By the Commission?

MR. MANEY: By the county and the city councilors. So when the action is taken by the area Coastal Planning Commission, it has already involved the chairmen of our counties, and the Mayors --

MR. TRAINA: Beyond planning, do you see a Commission such as yours involved in operating programs?

MR. MANEY: What did you say about operating programs?

MR. TRAINA: In terms of construction facilities --

MR. THOMAN: Extending beyond political jurisdictions?

MR. MANEY: Let me answer that this way. The area Commission's major asset is that you break down the barrier of county lines. You have included an area -- you look at it as a region.

MR. HOWARD: You're going to have a Chamber of Commerce type of person or biologist to make decisions about such things as we are talking about here?

MR. MANEY: Yes, that's right.

MR. HOWARD: You're going to have a lot of competition with us.

MR. MANEY: We will do research in the land-use planning, but as far as just taking this estuary, we would work strictly through the agencies such as are already in existence.

One of the requirements of a federal grant for Farm - Home Administration, say, for water and sewer development of a small community -- take Darien or some other community that would be affected in the estuary, they have to have that approval, a letter from out office saying that it is not in conflict with our overall planning program.

MR. THOMAN: It may not be in conflict, but it would be the best way of doing something. This is a negative type of approach.

MR. HOWARD: He would have to come through our office for the approval of the sewage or sewage treatment plant, and so we would be in a position to advise you if you asked us.

MR. MANEY: Well, that definitely would be the procedure.

MR. THOMAN: Mr. Maney, let me ask you one question. Does this permit you to be an operating agency, or does it specifically prohibit you from being an operating agency?

I'm getting back to the question that Mr. Traina asked -- could you build regional waste treatment facilities and operate -- does this act permit you to do this, or does this permit you just to plan?

MR. MANEY: No, it just permits us to receive gifts, grants.

MR. THOMAN: And plan?

MR. MANEY: Plan.

MR. JENSEN: Does the Commission have any plan to develop a land-use plan which would be compatible with these water-use classifications?

MR. MANEY: Definitely, as we progress, and in these programs that we are just starting - the Commission was formed in 1965 - in this particular area we just had its staff built up in the last year, and we would hope to have a master overall general land-use plan for open spaces, industrial usage, the commercial, all the way through for the six counties.

MR. JENSEN: Do you regard the water areas of an estuary as open space?

MR. MANEY: I believe it would, sir.

MR. JENSEN: I notice in Section 6, you are to have a master plan. Did you mention when that would be completed?

MR. MANEY: The master plan, sir?

MR. JENSEN: Yes. The functions are being carried on now. There is no deadline on that.

DR. SINGER: You're working toward it?

MR. MANEY: That's right.

DR. SINGER: You're preparing it?

MR. MANEY: Yes.

DR. SINGER: You're working through the County Planning Commission?

MR. MANEY: We are in the process of trying to establish a planning committee locally in every county that will implement our program.

MR. THOMAN: Are there any other questions? Does anyone else wish to say anything?

DR. ODUM: Could I speak as a private citizen here?

MR. THOMAN: Yes, you may.

DR. ODUM: There is something that distresses me very much about some of the testimony we have had here about estuarine pollution. I would like to see if we could clarify it.

For example, it's hard to understand why it would be that a new industry, new paper mill, for example, should be expected, under the American system of competition, to pay for the cost of advanced engineering, which we all applaud.

It does not seem to me in the American free competition theory that this is right for the latest comer who is going to do things right or who under duress is going to be made to do so.

What I am trying to say -- in other words, here's two boxes, and why should the customer pay two cents more for this box, and therefore, probably not buy it, because he isn't told that that two cents went for his recreation or something of that sort?

What I'm getting at is, the paper industry is well organized, it's concerned, but why isn't the cost of engineering of this sort spread around and all the mills take part in this, because they are all going to benefit, they are going to have to put this advanced engineering in anyway?

I feel very much for our friend who is starting a new industry and going to do it right. This is unfair competition to single out one particular mill to do the right job, when you're not going to do this to the others. I don't understand this.

MR. HOWARD: You want me to speak on that?

MR. THOMAN: You certainly may.

MR. HOWARD: No single industry has been singled out. If you want to know about that particular mill, it was probably one of the most unique sites anybody ever considered for a paper mill.

DR. ODUM: I know.

MR. HOWARD: Nobody singled them out. They got themselves into a corner insisting on that site, and that's a fact of life. Now, we had to face the facts of life. We had to protect the oyster and blue crab industries and the sport fishing that was just as important to a lot of people along the coast as Interstate Container.

Now, we had to make certain judgments about the degree of treatment, and it's probably the highest degree of treatment that ever was imposed on a paper mill in the Southeast, but we didn't have any choice.

We had to make judgments and make decisions. Now, they didn't have to go in there. They made the decision themselves.

DR. ODUM: They made this decision, so if they go out of business, they know what they were getting into.

MR. HOWARD: Right. We did not discriminate against them at all.

DR. ODUM: If we had had a reasonable use zone here, then they would never have gone in there?

MR. HOWARD: I'm not sure about that.

MR. THOMAN: There were probably some facts on this that are not available for public scrutiny.

MR. HOWARD: They're available. They are in my office. You can come and look at them.

(Whereupon discussion was held off the record.)

MR. THOMAN: Mr. Verross.

MR. VERROSS: The first thing I think we ought to understand is that Interstate came to Liberty County through the efforts of the Coastal Area Planning Commission and Liberty County Industrial Authority.

We did not go barreling our way into Liberty County and say we are going to put one here. We were invited to come as a part of the economic improvement of a depressed area.

After we got there, we found out certain conditions that said we had to choose between going elsewhere or designing a waste treatment plant to meet the requirements imposed by the Georgia Water Quality Control Board.

As a part of doing it, we were looking around for some place to do the research, because we found that the research didn't really exist, so we had our choice of going to the Water Board to have it done, we had our choice of going to the Institute of Paper Chemistry, we had a number of private firms to bid on the work.

Our first choice at the time was to have it done through a government agency. There were many people at the time who said that's a mistake, because they are liable to crucify you, and they could have, but they didn't.

And I'm saying again, that I think it proves something that when you fellows will go and do research without any preconceived ideas, the answers are going to come up -- I think they are going to surprise some of the marine biologists, but you have to take your chance on that one.

We came in by invitation.

MR. HOWARD: We are glad to have you, really, under our conditions. (Laughter)

MR. THOMAN: Does anyone else have anything to say?

MR. HOWARD: I do think you ought to read a brief part of this John M. Henderson report.

It's really a great piece.

MR. THOMAN: We are going to send copies of the transcript to everyone.

MR. HOWARD: You swear? This ought to be up to the public, of course.

MR. THOMAN: Everyone who has attended the meeting and has registered, will receive a copy of not only the transcript, but the other material which we incorporate in it and which has been or will be submitted for the record.

I want to thank each and every one of you for being here and sitting through this with us. I'm quite confident that there has been more than one real good idea to come out of this today.

In fact, I think as we peruse the material, we are going to find quite a few good ideas. This, incidentally, was a much more successful meeting than our one in Mississippi.

Probably we did a little better job on getting people in here. You certainly all are to be commended for helping us and for the very fine statements that were presented today.

Thank you, and the meeting is adjourned.

(Whereupon the meeting adjourned at 3:25 o'clock p.m.)

W. S. (BILL) STUCKEY, JR.
8TH DISTRICT OF GEORGIA

[illegible]

COMMITTEE:
AGRICULTURE

Congreſs of the United States
House of Representatives
Washington, D.C. 20515

February 14, 1968

Mr. Eugene T. Jensen
Chief, Office of Estuarine Studies
Federal Water Pollution Control Administration
U. S. Department of the Interior
Washington, D. C. 20242

Dear Mr. Jensen:

Thank you for your letter of February 13 regarding the public meeting which will be held at the Aquarama Convention Center on Jekyll Island on February 29, 1968, to discuss estuarine preservation and development problems.

I just wish I could attend the meeting; however, Thursday is a heavy legislative day in Congress and I will not be able to leave Washington. Let me take this opportunity to wish you every success for your meeting and if there is any way I can assist you, please do not hesitate to let me know. I would appreciate a transcript of the meeting.

With best wishes, I am

Sincerely yours,

Bill Stuckey

W. S. (Bill) Stuckey, Jr.
Member of Congress

State Water Quality Control Board
47 Trinity Avenue, S. W.
ATLANTA, GEORGIA 30334

GEORGIA WATER QUALITY CONTROL BOARD'S STATEMENT TO THE NATIONAL ESTUARINE STUDY REPORT

Including the contiguous salt marshes Georgia has over 2,000 square miles of estuarine zone, extending approximately 115 miles from the Savannah River's mouth to the estuary of St. Marys River, at the Georgia-Florida line. During the past 40 years the great production potential of this State's estuaries, in terms of sea foods (oysters, clams, shrimp, crabs, fishes), has critically deteriorated due to contamination and pollution from sewage and various industrial pollutants. Possibly a third of the estuarine zone is closed to shellfish harvesting because of sewage contamination or has been rendered desolate by industrial wastes.

A considerable amount of damage to the estuarine nursery and feeding grounds of shrimp, fish and waterfowl is resulting from land developments (filling for subdivisions), marina construction and various dredging operations improperly planned and/or controlled. The same is true regarding pesticiding and fertilizing operations. Such pollutants, often subtle and long-term in their effects, reach estuaries by a number of routes; airplane and ground application of pesticides for mosquito control or crop protection, and uncontrolled discharges from manufacturers and users of such materials are examples.

The pollutional sources enumerated above are primarily responsible for the degradation and destruction of the valuable and beautiful marine resources of our estuarine environment. Immediate and concentrated efforts should be directed towards eliminating or abating these problems, most of which we have the technology and financial capacity to solve. We should avoid any "scatter-gun" approach to pollution control in our estuaries. The highest priority should be given to providing adequate treatment for all municipal sewage and industrial wastes presently being discharged untreated or inadequately treated. With cities and industries located on and discharging to major estuaries serving such uses as recreation and fishing, we are irrevocably committed to the multiple use concept for our major estuarine zones. Population and industrial development trends both serve to emphasize the urgency of the need to clean up the existing problems of our estuaries.

On the other hand Georgia has a number of minor estuaries involving small tidal rivers or creeks with an insignificant amount of fresh water inflow. It is unlikely that such tide water areas can stand the stress of the residual pollution from conventionally treated (secondary) sewage or industrial wastes. Such systems should be studied intensively to determine the economic and social feasibility of zoning them for refuges or natural wilderness areas, or specifying their use by selective industries employing specialized or advanced waste treatment methods. Estuaries have received natural pollution in various forms for many thousands of years, as evidenced by their fertility and great production potential. Hence, all pollution may not be detrimental to estuaries.

Abatement programs to clean up the Savannah and Brunswick estuaries by 1970 and 1972 have been developed by the Georgia Water Quality Control Board. These rather large estuaries have been critically polluted for many years by sewage and industrial wastes. Both estuaries are included in Georgia's monitoring and surveillance system recently established and will be subject to continuing water quality studies during the next few years. Less critical but serious pollution, principally from two industries, occurs on the Altamaha and St. Marys estuaries. Similar abatement programs have been developed for these waters.

The remaining estuarine zone of Georgia, between Darien and Savannah, has, for the most part, high quality water. The Ogeechee, Little Ogeechee, Riceboro, Altamaha and other minor estuaries support approved shellfish areas, sports fishing, blue crab and shrimp fisheries as well as recreational uses. These estuarial waters have been classified for recreation and fishing, propagation of game and fish.

The Riceboro River (North Newport) associated with Sapelo and St. Catherines sounds is the subject of a special 4-year biological-hydrological study to determine the effects of a kraft pulp and paper waste, with 90-95 per cent BOD_5 reduction plus chemical coagulation (color removal), on the fisheries of an estuary with limited dilution and little fresh water inflow. The study is being carried out by the Marine Institute of the University of Georgia, the U.S. Geological Survey in cooperation with the State Water Quality Control Board.

This investigation should be expanded and intensified to incorporate other areas of research related to protection of estuaries. The Riceboro estuary represents a unique, small river system, threatened by pollution from industrial waste and ultimately sewage (municipal and marine vessels). The discharge of the river is to Sapelo and St. Catherines sounds and connecting tidal creeks which support commercial oyster beds, a large shrimp and blue crab industry and excellent sport fishing. A significant amount of general information and data has been accumulated by the Marine Institute, in prior research and under the present study of the Sapelo marshes and adjacent waters. This estuary certainly offers some exceptional advantages for a broad and comprehensive study of the effects of existing and future pollutants. The State has plans to establish an oceanographic institute on nearby Skidaway Island, a barrier island off the Savannah coast.

Our recommendations for the conservation and protection of estuaries may be summed up as follows:

1. Special emphasis and high priority should be given by federal and state governments to clean up existing pollution from sewage and industrial wastes. State and federal aid to local government for sewage treatment plant construction should be substantially expanded. Where necessary state and federal enforcement actions should be accelerated to initiate abatement programs and to obtain reasonable, firm completion schedules.

2. There is a great lack of useful data on the effects of many pollutants, from sewage and industrial wastes, on the marine biota of estuaries. The optimum dilution factor needed to protect saline waters from various treated wastes needs to be determined. These are some of the areas in which applied research is needed. Also, the effects of natural pollution and fresh water inflow (natural and man-made) should be studied in relation to shellfish cultivation and propagation of shrimp and fish.

3. There should be investigations into the possibility of blending certain waste discharges in order to offset individual pollutional effects; e.g. a waste containing high concentrations of chlorides might offset one consisting of large volumes of fresh water (cooling water) inflow.

4. There should be economic and social studies to develop the values of estuaries for various uses and for aesthetic considerations and to determine the practicality of the zoning concept as opposed to the multiple use philosophy.

5. A pesticide monitoring and sampling program should be established on our estuaries, especially through the spring and summer seasons.

6. A shellfish and fish sampling and analysis program should be developed to study the effects of radiation and pesticides on fish, shellfish and other marine life.

7. New, precise methods are needed to determine the volume and patterns of flows in tidal basins.

We request that the attached copy of "Water Quality Study of Chatham County Waters", Technical Report No. 2 of the Georgia Water Quality Control Board be made part of this statement. This report contains a tremendous amount of data and general information on estuarine waters of the Ogeechee, Little Ogeechee, Savannah and other lesser tidal streams, all estuaries.

The Georgia Water Quality Control Board appreciates the opportunity to present this statement and requests that it be made part of the official record of the public hearing on estuarine pollution problems, held at Jekyll Island on February 29, 1968.

For the Board

R. S. Howard, Jr.
Executive Secretary

March 12, 1968

THE UNIVERSITY OF GEORGIA
Division of Biological Sciences
Athens, Georgia 30601

Saturday

Dear Jack,

I carried this to Atlanta last night hoping to see you at the Ga. Sci. & Techn. Comm. banquet. It was to be typed finally on Thursday, but both my secretaries failed to show up. Result I had four different typists working on it and two of them were really not secretaries. We spent all Friday correcting mistakes and retyping; this time with competent help.

The statement was prepared primarily by Frankenberg with Pomeroy, Linton and Odum contributing. If you require signatures on this, I will have to send them later.

Sorry about the goof up

(Signed) Scott

Utilization of the Estuarine Zone in Georgia

Submitted to:

The Federal Water Pollution Control Administration as a contribution
to the National Estuarine Pollution Study.

Statement by:

Biologists from the Division of Biological Sciences
of the University of Georgia

March 14, 1968

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I. Introduction - What is an estuary?

The term, estuary, has been variously defined (Lauff, 1967 "Estuaries" A.A.A.S.). However, the term is generally understood to refer to that coastal region in which the concentration of sea water is measurably diluted by fresh water run-off from land. The estuarine areas of the United States have been extensively utilized by man and some of our largest cities are built on the banks of estuaries. Estuaries have unique characteristics different from both fresh water rivers and the ocean. These characteristics often make estuaries particularly sensitive to pollution by man's activities.

Along the coast of Georgia much of the estuarine region is made of salt marsh and numerous branched waterways which drain the marsh. This estuarine region lies behind barrier islands and ranges from 6 to 10 miles in width. Other Georgia estuaries are simply river mouths. At the present time these areas are not being extensively used directly nor are they heavily developed for industry or recreation. However, increased use will be made of these regions in the future. Therefore, the time is right for a reasoned consideration of how these regions should best be utilized and of the effects which this utilization will have on the basic nature of the estuarine system.

The University of Georgia is making a substantial contribution to the study and development of Georgia's estuaries and sea islands. The academic schools and departments involved in this effort include Forest Resources, Agriculture, Landscape Architecture, Biological Sciences, Geology, Community and Area Development, Geography, and the Marine Institute. Current research and exploratory projects being undertaken by staff and students include studies in fisheries, aquaculture (growing of oysters and other seafood), game management, sedimentary geology, estuarine ecology, forestry, mineralogy, mineral cycling, productivity, oceanography, community planning, and natural beauty.

In this statement the University of Georgia will attempt to describe the basic attributes of the estuarine region and to evaluate the effects which various uses will have on this region. First, the statement will describe some physical and biological aspects of estuaries. Second, it will emphasize some of the unique features of the estuarine complex in Georgia. Third, it will relate some of the history of estuarine degradation along the east coast of the United States. Fourth, it will attempt to describe the uses and value of the salt-marsh-estuarine complex in its present form and the kinds of uses to which it may be put in the future. Fifth, it will discuss the effects of various pollutants which will probably be by-products of increased use of the estuarine region. Sixth, it will recommend plans for zoning of the estuarine region of Georgia so that incompatible uses and pollutants will be as widely separated as possible.

Part I - Physical attributes of the estuarine-salt-marsh complex.

A. Hydrography and Physical Attributes. Estuaries are regions where fresh water from the land meets and mixes with salt water from the ocean. Water containing different amounts of dissolved materials differs in density. Thus fresh water is less dense than the salt waters into which it flows, and therefore the fresh water tends to spread out over the surface of the salt water. In "longitudinal" section, the salt water appears as a wedge underlying the fresh water. This led D. W. Pritchard to refer to this type of salinity distribution as a salt wedge estuary. The salt wedge moves up and down the estuary in response to the flow and ebb of the tide. The combination of salt-wedge salinity distribution and tidal oscillation results in a unique estuarine circulation pattern which significantly affects the physical, chemical, and biological aspects of estuaries. Nutrients tend to be far more concentrated in this estuarine region than in the river or the ocean. Estuaries, therefore, are often termed nutrient traps. In addition to trapping nutrients, the estuarine water produces electrical changes on the surface of the clay particles being carried by river water. This change causes the particles to settle out on the bottom of the estuary, carrying adsorbed nutrients with them. Thus estuarine circulation traps both nutrients and sediments. As a result, the estuarine regions have high nutrient concentration and have large sedimentary deposits. The tremendous salt marshes of Georgia are a result of sedimentation of material of various origin, much of it having been brought to the estuaries by rivers draining the coastal plain and the Piedmont Plateau.

B. Biological Aspects of the Estuarine Salt Marsh Zone. Two biological aspects of estuaries require emphasis as background for consideration of development and possible pollutants in this environment. The first of these is the composition and distribution of the estuarine biota. The second is the mechanism by which this biota functions to produce a smoothly working system which produces food and cycles nutrients to maintain itself.

The estuarine biota is composed of relatively few species which usually occur in tremendous abundance. Thus the salt-marsh grass, Spartina alterniflora, is practically the only obvious plant species of the salt marsh, yet it occurs as millions of individual plants over many acres of salt marsh. The common salt marsh animals are also of relatively few species, including fiddler crabs, oysters, mussels and the hard clam. The number of species which live in the estuarine water column are also limited and include such organisms as the commercial shrimp, blue crab, and such fish as sea run trout, channel bass, mullet, and sheep's head. The abundance of the common estuarine species is so great, however, that commercial and sport fisheries exist for many of them. A great many other species utilize the estuarine zone during their early development. Estuaries are the nursery grounds of the sea, and some 90% of the commercial and sport-fisheries catch in coastal Georgia is of species whose juvenile stages must live in the shallow, protected waters of estuaries. The commercial value of an estuary depends not only on the commercial catches of adult organisms, but also on the use of the estuarine zone by juveniles of other commercial species which may be harvested from the estuary.

The other significant phase of estuarine biology involves the mechanisms by which the estuarine biological system functions to produce food and cycle nutrients at rates required to support the adult and juvenile populations which live there.

The rate of production of organic matter of a biological system is termed productivity. The organic matter produced can serve as food for man and other animals. Primary production generally refers to the rate of production of organic matter by plants, because these organisms can trap energy from sunlight and convert it to the organic matter which is used as food by other organisms. The rate of primary production in Georgia salt marshes is higher than that of any other natural system yet investigated (3300 grams organic matter per square meter per year, Odum, 1959). Thus the salt marsh produces plant material at a rate comparable only with that found in the most highly intensive agriculture, such as that practiced in sugar cane fields where several crops are harvested every year.

Scientists at the University of Georgia Marine Institute have discovered that not only are the marshes very productive, but so are the coastal waters. In fact, the zone from the beaches to approximately 25 miles offshore has a rate of production as high as any known in the World Ocean. There is good reason to believe that the high coastal productivity is related to the productivity of the marshes and that it is limited to the zone where water coming out of the marshes mixes with the clear ocean water. Other sections of the coast having equal amounts of river flow but less productive marshes do not have such a productive coastal zone. The substances in marsh water which contribute to high coastal productivity include both inorganic nutrients (phosphorus, nitrogen) and organic ones (vitamin B_{12}).

The nutrient-trap effect of estuarine circulation has been alluded to as a significant aspect of the estuarine region. In Georgia estuaries the average concentration of phosphorus coming down the rivers is very low, but in the estuary the nutrients are trapped and the concentration increases. This high concentration of nutrients is cycled from the water to plants and animals and back to the water again. All of the biological processes involved in these cycles are not understood, but scientists at the University of Georgia Marine Institute have clarified some of them. Great care must be utilized in altering these systems. Changes may well have unexpected and unplanned-for results.

Another aspect of the functioning of any biological system is the mechanism by which essential gases are supplied to organisms. Most common organisms require oxygen in the biochemical processes whereby they obtain energy from their food. A biological system which is operating close to its maximum possible rate needs large quantities of oxygen to supply the respiratory requirements of its component populations. As a result, many highly productive aquatic systems have a critical balance between oxygen supply and demand. Small changes in this balance can have catastrophic effects for the whole system. Most of our estuarine waters in Georgia are saturated with oxygen. However, the creeks in the interior of marshes may at times have very low levels of dissolved oxygen and may even go anaerobic for short periods. Naturally, any additional oxygen demand will have adverse effects by limiting the oxygen concentration still more. We can, therefore, confidently predict that addition of organic matter or other oxygen-demanding materials may make certain sections of the Georgia estuarine zone anerobic, with adverse effects on the species which inhabit these areas.

II. Unique Features of Georgia Estuaries.

There are several features of the estuaries of Georgia which are unique. These include the extent of the estuarine zone, its relatively unspoiled nature, and its high biological productivity.

The extent of the Georgia salt marsh is presented in Table 1, a summary of the number of salt-marsh acres in each of the coastal counties.

TIDAL MARSH LAND AND TIDAL SWAMP
COASTAL AREA OF GEORGIA 1/
December, 1965

County and Acres	Salt Water 1/ Tidal Marsh Acres	Fresh Water 2/ Tidal Marsh Acres	Tidal Swamp Acres	Total Acres
Bryan 280,960	16,858	1,800	5,000	23,658
Camden 419,840	47,860	1,500	4,000	53,360
Chatham 282,240	71,829	12,330	4,500	88,659
Glynn 270,720	89,406	1,560	4,650	95,616
Liberty 326,400	54,760	1,245	--	56,005
McIntosh 275,840	77,485	5,647	4,500	87,632
Totals	358,198	24,082	22,650	404,930

1/ Estimated acreages except in McIntosh County, Bryan County, and Glynn County

2/ A varying transition of brackish conditions exist between salt water tidal marsh and fresh water tidal marsh.

Quarterly Report
U. S. Soil Conservation Dept.
Flanders - Waycross

The barrier islands of Georgia lie further from the mainland than those of any other state except for the islands of the Mississippi delta. As a result, the estuaries and salt marshes behind these islands are more extensive than any others. Georgia has more salt marsh and estuary per mile of coastline than any other state.

At present, the tremendous salt marshes and estuaries of Georgia are relatively unspoiled. Large tracts of these marshes have never been ditched or sprayed, and relatively few acres have been filled for industry or seriously affected by pollution. This relatively unspoiled area contrasts so markedly with that of other states that it can be cited as a unique aspect of Georgia's estuaries. Changes are on the way, however, and this unique feature will be lost if its value is not soon recognized.

The Georgia estuarine and coastal zone is also the most productive of the Atlantic coast. This is a function both of the great extent of this habitat, its southern location and consequent long growing season, and the great tidal range. Natural biological productivity is a renewable resource of continuing value to a world facing a population explosion and a food crisis. It should not be traded lightly for more economical waste disposal or extractive production of minerals.

III. History of Estuarine Degradation on the U. S. East Coast.

1. New York and New Jersey.

Before the turn of the century there was a thriving oyster fishery in Raritan Bay, the lower part of New York Harbor. The marshes bordering northern New Jersey were as unspoiled as most of Georgia's are today. As the population and industrialization of New York increased, oysters became unsafe food. At present, oysters are virtually nonexistent in most of the area. Menhaden, which used the estuary as a nursery ground, are killed by pollution and are found floating in the bay. Shad runs on the Raritan River ended early in this century.

The marshes of southern New Jersey have undergone changes associated with recreational uses. Mosquitoes pose some nuisance problem in coastal areas, and it was believed that salt-water pools in the marshes were their principal breeding grounds. Actually, it is doubtful if the salt-marsh mosquitoes are a significant pest. Most of the nuisance probably comes from fresh-water mosquitoes that breed in woodlands along marsh edges. In the early 1900's nearly all the New Jersey marshes were systematically ditched to circulate water in the marsh pools. This changed the character of the marshes somewhat but not radically. In the 1950's aerial spraying of the marshes was begun. Again, this had little effect on nuisance mosquitoes, but had profound effects on the marsh animals. Many invertebrates, such as crabs, were killed wholesale. So were juvenile menhaden. Spraying has reduced the productivity of fishes and fish-food organisms substantially without achieving its object.

Large areas of marsh in New Jersey have been filled to make waterfront real estate. This, of course, eliminates production of fish and shellfish. The value of the fisheries is traded for increased land and taxation values.

This may be a good trade in the short term, but such areas are vulnerable to storm surges and are potential hurricane-disaster areas.

For many years the state of New Jersey purchased marshland to preserve it as wild land. In this way, some sections will continue to produce renewable fishery resources and will be suitable for recreational uses. In northern, urban-industrial New Jersey the marshes are given over largely to industrial functions which are not compatible with renewable marine resources. In southern, rural New Jersey the marshes still support fisheries, hunting, and other recreations, as well as a salt-hay industry.

2. Florida

In Florida the development of waterfront real estate probably has had the greatest effect on marshlands and estuaries. Some bays, notably Biscayne and Boca Ciega, have been so modified by land fills that their area is substantially reduced and water circulation modified in such a way that water pollution problems are enhanced. Landfill in Florida has been encouraged by intentionally loose legal definitions of a shoreline or bulkhead line, and by a permissive attitude toward requests to fill shallow parts of the bays. However, it is now realized that some filling has been excessive and not in the public interest. Some recent requests for fill permits in the Tampa Bay area were denied, following public hearings.

In the most densely populated parts of Florida there are growing problems of pollution. Inadequate sewage plants are a major problem, making extensive areas unsafe for shellfish harvesting and for recreation. The realization has now come that it is necessary to invest in pollution control in order to preserve land values and the tourist industry.

3. New England States

The New England states present a contrast in approaches toward utilization of marshes. In Connecticut more than half of the salt marshes have been filled or modified, and there is no effective legal restraint. By contrast, Massachusetts has the most stringent and effective legal controls on the modification of marshlands. Their public value as renewable resources is recognized, and the owner does not have the legal right to make modifications that will be deleterious to fish and shellfish production. This legal control has been tested in the courts and upheld. Of course, owners of such property are taxed at a rate appropriate for undeveloped marsh. Income from fisheries and recreation is considered to be more important than development of a fringe of high-value, high-risk building lots.

4. General course of human use of marshes.

The use of marshes has taken several forms. In their natural state, marshes are utilized for recreation and fisheries. They contribute importantly to coastal fisheries such as menhaden and many others. These uses of marshes usually are associated with low population densities, but in Massachusetts protected marshes exist in areas where there is high-density recreational use and where fisheries remove the highest sustainable yield. It should be remembered that marshes are exporters of organic and inorganic nutrients, so that they influence the productivity of fisheries well beyond the marshes. Marshes will tolerate moderate amounts of municipal and industrial pollution. They are quite sensitive to insecticides, although the effects are not obvious to casual observers.

In some regions a portion of the marshes have been filled and otherwise modified as real estate developments, while adjacent marshes remain in a natural state. Where only a small part of the marsh is modified, this usually proves to be compatible with a sustained production of renewable resources in adjacent marsh. Where filling is excessive, the marsh-estuarine system becomes unproductive and of reduced recreational and aesthetic value. Many expensive waterfront homes now overlook stagnant, odoriferous water, populated by few fish, and unsafe for swimming. The carrying capacity of the whole system has to be considered. There is now enough scientific knowledge of estuarine processes to do this effectively.

In urban centers marshlands inevitably are turned over to industrial use. Many are filled to provide waterfront industrial sites. What remain are heavily damaged by industrial-urban water pollution. It has to be recognized that natural marshes are not compatible with heavy industry or metropolitan centers. In such areas, marshes unquestionably are more valuable as real estate than as a renewable natural resource. The most populous city in the world, Tokyo, is built on former salt marsh. So is much of the heavy-industry area of metropolitan New Jersey.

Part 4 - The Uses and Value of Estuaries and Salt Marshes in Georgia

The estuaries and salt marshes of Georgia are presently being used for a variety of purposes. These include industrial uses; recreational uses; commercial fisheries and research. This diversity of uses should be encouraged so as to provide Georgia with the diversified development its citizens deserve. It is clear, however, that some of these uses of the estuarine zone are not compatible. Obviously heavy use of an estuary for industrial waste disposal is incompatible with its use as a study area for fundamental research into the functioning of a natural system. Therefore, it seems reasonable that developing the Georgia estuarine zone for diversified use will require that incompatible uses be separated as much as possible.

In Georgia we are relatively fortunate in that such separation of incompatible uses has developed naturally along with the development of the coastal region. The estuaries used by industry are primarily concentrated in the vicinity of Savanah and Brunswick. The estuaries used for research programs are concentrated in unspoiled coastal regions such as Sapelo Island, where the University of Georgia Marine Institute is located. Estuaries jointly used for recreation and commercial fishing are located between the industrial and research areas. Thus the least compatible estuarine uses are already isolated from one another by areas with two or more compatible uses. These areas of estuarine uses also correspond to the sensitivity of the use to the pollutants associated with developed estuaries. Thus the industrial areas have the heaviest pollution load, the research areas have the lightest, and the recreational and commercial fishery areas have an intermediate load. Thus the existing uses of Georgia estuaries provide a base upon which a rational plan for the development of the Georgia coast can be built. This plan must include mechanisms whereby pollutants of various sorts, which appear to be an unavoidable by-product of development, can be isolated from those regions which must be maintained as natural as possible.

Present Use and Values of the Georgia Estuarine Zone

A. Industrial

Waste disposal is the primary industrial use of Georgia estuaries at the present time. Various industries dump their oxygen-demanding materials into the Savannah River estuary with the result that much of the lower reach of this stream is anaerobic for part of the year. Similarly, in Brunswick, wastes are dumped directly into the estuary, but the oxygen concentration has not reached such low levels as it has in Savannah owing to the smaller waste loads of the Brunswick region. It is difficult to assess a value for the use of an estuarine region as a mechanism for waste disposal. Certainly the value must be quite high, as the estimates for resolving the oxygen problems of the Savannah River are almost prohibitively expensive.

B. Recreational

All of the estuaries of the Georgia coast are presently being used for recreation. Some of these estuaries such as the Savannah River are inappropriate for this use as a result of the high pollution load which they are already carrying. The majority of the estuaries are appropriate recreational areas, and they are being used for boating, water skiing, sport fishing and hunting. The value of this recreational resource is difficult to estimate, but the Georgia Game and Fish Commission has calculated that the recreational expenditures for sport fishermen alone was $51,000,000 in 1963. Clearly the value of the estuarine zone of Georgia as a direct recreational resource is tremendous. In addition to the direct use, the aesthetics of an unpolluted habitat is a substantial part of the appeal of the Island resorts of Georgia. Thus the indirect use of the relatively unspoiled estuarine zone is one important basis of the coastal tourist industry.

C. Commercial Fisheries.

A substantial estuarine-based commercial fishery presently exists in Georgia. The commercially important estuarine species include shrimp, crabs, oysters, menhaden and shad. The total value of commercial fishery landings in Georgia was about $10,000,000 in 1965. (Lytel, C. H., 1965 Fishery statistics of the U. S., Statistics Digest (58), U.S.F.W.S., Bureau of Comm. Fish.) This value does not represent the total value of the commercial fishery, because it does not include the expenditures for labor, supplies, equipment, handling, and processing which are an integral part of any commercial fishing industry. Neither does it include fish caught on the continental shelf off Georgia but landed in neighboring states.

D. Research

Several research laboratories are located in the estuarine regions of Georgia and are dependent upon an unspoiled environment in which to carry out their studies of basic estuarine and ecological phenomena. These laboratories include the University of Georgia Marine Institure located on Sapelo Island. Dr. V. J. Henry, the director of this laboratory, will present a statement regarding this laboratory's use of the estuarine environment. The United States Fish and Wildlife Service operates two research laboratories in the coastal zone of Georgia, including the Fisheries Biology Laboratory at Brunswick and the Commercial Fisheries Laboratory on St. Simons Island. Statements from both of these laboratories regarding their use of the estuarine zone will be submitted directly by the United States Fish and Wildlife Service. The State of Georgia Game and Fish Commission operates a coastal laboratory in Brunswick, and this laboratory's use of the estuarine zone will be the subject of another statement. The Skidaway Oceanographic Research Institute was established this year on Skidaway Island.

Future Use and Values of the Georgia Estuarine Zone

A. Industrial

The Industrial uses to which the coastal zone of Georgia may be put include the use of the water courses for waste disposal and transporation and of the underlying mineral resources.

Waste disposal by direct dilution into natural water courses is inexpensive to the polluter but expensive to his downstream neighbors. Waste disposal in Georgia is now supervised by the Water Quality Control Board, and controls on pollution are developed through this agency.

The estuaries and coastal zones of Georgia may also be utilized as sources of minerals. The minerals which might be present include heavy minerals in the beach sands, phosphate deposits beneath the marshes and estuarine bottoms, and petroleum deep beneath the surface. The first two of these mineral types provide a relatively low return to the miner. Mining for these deposits therefore depends on the availability of relatively large tracts of land for which the mineral rights are relatively cheap. Few such tracts exist on the islands or in the marshes of Georgia, primarily because of the landowner's appreciation of the greater potential return which can be realized through alternate land uses. The state-owned mineral resources of the continental shelf, however, do present an opportunity for extractive mining for heavy minerals and phosphates. Development of these resources should be carried out under careful supervision so that the offshore environment will be altered as little as possible. The possible financial gain associated with this type of offshore mining should be carefully weighed against the potential damage which might be done to the recreational and fishery values of the environment.

It is possible that petroleum deposits may exist beneath the estuarine zone of Georgia. If such deposits are present, they should be developed so as to provide an added impetus to the economy of the state. Techniques for removing petroleum without greatly altering the surface environment have been developed and should be stringently applied to any petroleum mining in the coastal region of Georgia. This can be done only by adoption and enforcement of appropriate legal safeguards.

B. Recreation

It seems clear that the recreational use of estuaries will increase substantially. Citizens of the United States have more money and more leisure time than ever before, and the upward trend of both is continuing. These trends will lead to greater pressure on recreational resources, such as the estuarine region and particularly in southern states where long outdoor recreation seasons exist. The recreations man will choose will, in large measure, be determined by the recreational facilities available to him.

Efforts should be made to develop and maintain a spectrum of facilities so that the diverse requirements for recreational resources can be met.

Some recreational activities, such as houseboating and overnight camping are potential pollution sources. These intensive recreational activities should not be discouraged, but their point of impact should be confined to those areas which will do the least damage to the total system.

In addition to regulating potential recreational pollution sources, efforts should be made to provide activities which stimulate the mind and provide tourists with the facilities and information necessary for them to explore and appreciate the natural world of which they are a part. Environmental Interpretive Centers for tourists should be established in unspoiled areas of the estuarine zone. Recently a terrestrial recreation research center, located in the north Georgia mountains, was funded by a two million dollar loan from the Federal Economic Development Administration. A project similar to this should be established to serve planners and administrators of the estuarine environment.

Inherent in all recreational uses of the estuarine resource is the philosophy that man's activities should not unnecessarily affect the resource upon which his recreation is based. Thus pest control programs should not involve indiscriminate spraying of marshes in hopes of controlling mosquitoes. The sad history of man's effort at mosquito control by these methods has been documented in New Jersey, Delaware and elsewhere. Generally the adverse effects of spraying have been felt most by the non-insect inhabitants of the marsh such as menhaden, sea run trout, shad, fiddler crabs and others. Naturally, any diminution in the numbers of these animals will diminish the sport fishing and other recreational uses of the estuarine zone.

C. Commercial Fishing

Many aspects of the marine commercial fishery in Georgia can be expanded. The relatively high biological productivity and unspoiled nature of the estuarine region offers great potential for developing the commercial fishery above its current level. Some of this development depends on the development of new methods, but much of it depends only on the application of existing methods to the Georgia situation. The great advantage of exploiting the commercial fishing possibilities is that these activities are compatable with the recreational uses of the estuarine region and may even enhance the tourist's enjoyment of this resource.

Shrimp harvest in Georgia is already providing an annual income of $5,000,000. This income is equivalent to that derived at 5% interest from an investment of $100,000,000. Shrimp are animals almost uniquely suited to aquaculture techniques, and such techniques have been developed and demonstrated at the Bear's Bluff

Laboratory in South Carolina. Application of these techniques to the nearby situation in Georgia should increase the monetary return from the shrimp harvest substantially.

The crab industry in Georgia currently returns about $2,000,000 annually and the catch could probably be doubled with increased mechanization. In addition, the softshell crab industry which thrives in Chesapeake Bay could well be adapted to the Georgia situation with resultant increase in the return from crab fishing.

The Georgia oyster industry is currently landing about $500,000 worth of oysters annually. These landings can be increased substantially, and techniques for doing this are currently being developed by research projects at the University of Georgia Marine Institute.

The finfish industry in Georgia is currently harvesting shad and menhaden primarily. Each of these fisheries produces about $1,000,000 annually. The finfish industry could be increased with additional efforts. Substantial commercial populations of snapper and bass have been discovered off the Georgia coast by the U. S. Fish and Wildlife Service's Exploratory Fishing Laboratory in Brunswick. In addition there are substantial quantities of so-called "trash fish" being captured in shrimp trawls. These could provide additional income if distribution mechanisms were developed and a fish-meal plant were established.

D. Research

The research use of the estuarine zone of Georgia will be emphasized in statements by the University of Georgia Marine Institute, the United States Fish and Wildlife Service, and the State of Georgia Game and Fish Commission. The uniquely unspoiled estuarine environment of Georgia will increase in research value for it is becoming one of the few areas on the East Coast where pre-pollution conditions can still be assessed. An indication of the value derived from research use of the estuarine environment can be seen in the fact that during the last 3 months alone, the University of Georgia has received over $1000,000 in federal support for new and continuing research projects at the University's Marine Institute on Sapelo Island.

V. Effects of various pollutants on the Estuarine Zone of Georgia

The types of pollutants which will be associated with the development of the estuarine zone of Georgia can be predicted with reasonable assurance. These pollutants will include oxygen-demanding materials of various sorts, heat from industrial cooling processes, nutrients from domestic sewerage and agricultural fertilizers, pesticides from control programs, and disease agents from domestic sewage. The effects of these pollutants can be predicted from what we now know of the coast of Georgia and of other areas where these pollutants have already been released.

Oxygen-demanding materials will probably be the primary pollutants during the early phases of coastal development. This has been the case in other areas and is a result of the diversity of pollutants which require oxygen for their degradation. These oxygen-demanding materials include organic wastes from human habitation (sewage and garbage) and industrial wastes such as food processing remains the effluents from pulp and paper mills. The great sensitivity of productive aquatic environments to low oxygen levels is well known, and the occasional anerarobic conditions in the creeks of the Georgia marshes has been described above. It is therefore clear that the estuarine zone of Georgia will be sensitive to oxygen-demanding wastes, and overloading the system's ability to supply oxygen for the degradation of these materials will risk extensive damage to the natural system. Therefore, the dumping of oxygen-demanding materials into the estuarine zone should be even more carefully controlled than situations in which these wastes are dumped into less sensitive biological systems. Industrial use of oxygenating ponds should be an absolute requirement.

Heat pollution poses no immediate problem in Georgia estuaries. Should such uses of estuarine water be considered in the future, however; the applications should be carefully studied. The back and forth movement of estuarine circulation means that cooling waters may be reused several times before leaving the vicinity of the plant. This results in the environmental temperature being raised substantially more than would be the case if the water was used for cooling only once. Such multiple use and additive temperature increase is forecast for the Atomic energy powered generating plant currently under construction on the Patuxent River in Maryland. Even minor additions of heat may have adverse effects on the already warm waters of Georgia estuaries due to the inverse relationship between water temperature and the amount of oxygen which can be dissolved in it. Warm water can contain less oxygen than cold water. Thus heated waters will be even more sensitive to adverse effects of oxygen-demanding materials than cool waters would be.

Nutrients are another class of pollutants which have a variety of sources and which can result in the decrease of the oxygen concentration in aquatic environments. Nutrients can enter an estuary in run-off from well-fertilized agricultural fields, in sub-surface drainage from domestic septic tanks or cesspools, and from a variety of industrial applications. Once in an estuary, the nutrients are trapped by the estuarine circulation described above. These nutrients are utilized in the growth of plants. In unproductive situations, this can increase the productivity in beneficial ways. However, in the already productive estuarine zone more plants are produced than can be supported by the nighttime oxygen supply. As a result the plants become oxygen-demanding with the same adverse effects as have been described above. Therefore, nutrients, like heat, have adverse effects through decreasing the already limited supply of oxygen. Situations where nutrients have caused anaeobic conditions with consequent destruction of an estuarine recreational resource are well documented along the bays on the south side of Long Island, New York.

Pesticides are perhaps a unique pollutant in that they enter the environment only because of man's direct efforts not just through his laziness or inattention to detail. The adverse effect of pesticides on natural systems has been extensively documented through the popular press and such best-selling books as Rachel Carson's "Silent Spring". There are three major points which should be emphasized in a discussion of pesticide pollution of estuaries. The first involves the question of whether the pesticide application is likely to resolve the problem at which it is aimed. In the case of the salt marsh mosquito, there is considerable evidence that heavily funded pesticide application programs are directed at the wrong organism and environment entirely. The second point is that broad-spectrum pesticides kill indiscriminantly and destroy desirable as well as undesirable species. This point deserves special emphasis in estuaries where there are relatively few species and where the young of commercially important species develop. The third point is that biological systems concentrate pesticides to levels well above those in which they were applied. Scientists in New York have calculated that DDT in a sea gull may be about 1,000,000 times as concentrated as it is in the water to which it was applied (Woodwell, Wurster, Issacson, 1965, DDT Residues in an East Coast Estuary. Science). Indiscriminate pesticide application to such estuarine areas runs the risk of completely altering the smoothly functioning biological system and destroying commercially valuable organisms. Thus great consideration must be given before a pesticide program in estuaries should be undertaken.

Sediments are a pollutant resulting from almost any type of dredging and filling operations. Sediments have two effects, first they may cover over bottom organisms or interfere with respiration of swimming animals, and second they can release trapped nutrients or oxygen-demanding materials, thereby adversely effecting the oxygen concentration in the water. Both of these effects risk altering the natural habitat and biological system. Efforts should be made to contain the sediment spillage of any large scale dredging and filling operations.

Disease organisms may be spread in aquatic environments contaminated with human wastes. This obvious point is illustrated in the estuarine zone by well-documented examples of hepatitis transferral through oyster vectors in Alabama and Mississippi (Mason, and McLean, 1962. Infectious hepatitis traced to the consumption of raw oysters. American Journal of Hygiene 75:90-111.), and recently through the demonstration that fish may be infected with human pathogens and transfer them either to humans or to previously uncontaminated environments (Jannsen and Meyers, 1968. Fish:Serologic evidence of Infection with human pathogens. Science 159: 547-548). This evidence provides added impetus for requiring appropriate sewage treatment in estuarine areas where such disease vectors are common.

VI. Recommendations for use and pollution zones on the Georgia Coast.

The estuarine zone along the coast of Georgia is a valuable natural resource both for the State of Georgia and for the United States. This zone can and should be developed. The relatively natural current state of this region provides a great opportunity for channeling its development for maximun utilization.

There are certain general principles which should be recognized in planning the development and resultant pollution of this region. First, its uniqueness should be recognized. Second, the diversity of uses to which it can be put should be appreciated. Third, the incompatibility of some possible uses should be recognized and these uses isolated from one another. Fourth, specialized areas with limited uses should be small, and generalized areas with many uses should be large. And fifth, the present use of the coastal region should provide the basis around which further development should be planned. These principles underlie our recommendations for the development of the estuarine region of Georgia, and the pollution loads which should be tolerated in various areas.

We recommend that five types of use zones with separating buffers be established in the estuarine region of Georgia. These zones should be used differently, should have different pollution tolerances, and should be protected differently. The five zones are described in the following paragraphs and the regions enclosed by each zone are illustrated on the map presented as Figure 1.

Zone 1 Heavy Industrial and Port Zone

This zone consists of the area between the South Carolina border and Ossabaw Sound. The Savannah River is heavily polluted by industrial and domestic wastes, and is a major port. Additional industries should be required to treat their wastes in accordance with the requirements of the State of Georgia Water Quality Control Board. Efforts should be expended to keep the entire area as unpolluted as is consistent with good industrial practice. It now appears that Savannah might best be considered an "Industrial River", and heavy industrial water users might best be located along its banks rather than distributed throughout the coastal region. There should not necessarily be any additional controls placed on the private development of this zone.

Zone 2 Recreation and Commercial Fisheries Zone

This zone consists of the areas between Ossabaw Sound and the middle of Saint Catherine's Island. This zone has always been used for commercial fisheries and recreation and is relatively unspoiled. Unfortunately this zone is currently being developed for waste disposal by a Kraft process paper mill in Riceboro which will empty its waste water into the upper reaches of the Newport River.

The location of this mill in an otherwise undeveloped zone is an example of the kind of incompatible uses which develop in the absence of any overall plans for coastal development. The pollution effects of this mill should be carefully monitored and the adverse effects kept to an absolute minimum by whatever legal methods are available. The remainder of this zone should be protected against further industrial encroachment either through the use of voluntary legal encumbrances which land owners might sell or contribute to such conservation agencies as the Georgia Conservancy, or through "open space easements" as recommended and discussed by the Open Space Action Committee (Stewardship, 1965. The Open Space Action Committee, New York, N. Y. v+82pp.)

Zone 3 Research Zone

This zone includes the areas between Sapelo and Doboy Sounds and includes Sapelo and Blackbeard Islands. Blackbeard Island is a United States Wildlife preserve, and Sapelo Island is largely under the control of the Sapelo Island Research Foundation, privately funded research supporting agency. Stringent controls should be placed on any pollution in this zone to maintain the unpolluted natural habitat required for base line research on natural systems. The marshlands in this zone which are not now protected by ownership by federal and private research foundations should be acquired by direct purchase by private foundations, the State of Georgia or the United States and set aside as an environmental research park. This would be a unique research area which could serve the entire eastern United States. The uniquely unpolluted estuaries of Georgia are practically the only areas in the eastern United States where such a large research park could still be established.

The time for establishment of such a park even in Georgia is short, so, this recommendation requires prompt positive action if it is to be realized.

Zone 4 Light Industrial, Recreational, Commercial Fisheries and Port Zone

This zone extends from Altamaha Sound to Jekyll Island and includes Sea Island and Saint Simon's Island as well as the estuarine regions around Brunswick. The uses we recommend for this zone are those to which it is already being put. Further development of this zone should be carried out with strict attention to the water quality standards of the State of Georgia Water Quality Control Board. Waste disposal policies should be as strigent as is consistent with good industrial and municipal practices to conserve the recreational potential of the area.

Zone 5 Wilderness Preserve, Seashore Park and Commercial Fisheries Zone

This zone extends from Saint Andrews Sound to the Florida border, and includes Cumberland Island. We recommend that the United States government obtain Cumberland Island for a National Seashore and develop part of the Island as a Seashore Park and part as a wildlife preserve. Commercial and recreational fisheries should be allowed access to the subtidal lands and waters. Pollution in this zone should be kept to an absolute minimum.

Buffer Zones

In general each of the use zones should be separated by a buffer zone to further separate the incompatible uses. These buffer zones should be protected by some type of legal encumbrance or easement such as those recommended for Zone 2.

GENERAL PLANNING ENABLING ACT OF 1957

No. 358 (House Bill No. 400)
(Including all amendments through the
regular 1967 session of the General Assembly)

BE IT ENACTED BY THE GENERAL ASSEMBLY OF GEORGIA:

SECTION 1

PLANNING COMMISSIONS: CREATION AND APPOINTMENT. - The governing authority of each municipality in this State is authorized to create by ordinance a municipal planning commission. The governing authority of each county in this State is authorized to create by resolution a county planning commission. Any two or more municipalities are authorized to create a joint planning commission. Any two or more counties are authorized to create a joint planning commission. Any one or more counties and any one or more municipalities in any one or more of these counties are authorized to create a joint planning commission. The governing authority of any municipality or county that has participated or participates in creating a joint planning commission may continue and may create or retain its own local planning commission whether under the authority of a private act, general enabling legislation, or other authority. Any county or municipality which has or which may create its own local planning commission and which also participates in a joint planning commission may specify in the respective resolutions or ordinances which powers granted shall be exercised by the local planning commission and also the joint planning commission. Wherever the terms, "Municipal Planning Commission", "County Planning Commission", or "Municipal-County Planning Commission", are used hereinafter, they shall be construed to mean and shall include any planning commission established hereunder. The governing authorities of the political subdivision or subdivisions creating a planning commission shall select the name of the commission, but such a name must include the term "Planning Commission". A planning commission shall be composed of members who shall be appointed by the governing authority or authorities of the political subdivision or subdivisions creating the commission. A majority of the members of a planning commission, except multi-county planning commissions, shall be persons who hold no other public office in the municipality or county from which they are appointed. Ex-officio members of the commission who hold public office shall serve on the commission during the time they hold such public office. Other members of the commission shall be appointed for overlapping terms of three, four, or five years and shall serve until their successors are appointed. Original appointments may be made for a lesser number of years so that the terms of said members shall be staggered. The compensation of the members, if any, shall be determined by the governing authority or authorities of the political subdivision or subdivisions creating the commission. Any vacancy in the membership of a planning commission shall be filled for the unexpired term in the same manner as the original appointment. The governing authority or authorities of the political subdivision or subdivisions creating the commission are hereby authorized to remove any member of the commission for cause after written notice and public hearing.

SECTION 2

PLANNING COMMISSION: ORGANIZATION, RULES, STAFF, OFFICERS, AND FINANCES. - The municipal planning commission, the county planning commission, or the municipal-county planning commission shall elect one it its appointive members as chairman who shall serve for one year or until he is re-elected or his successor is elected. A second appointive member shall be elected as vice chairman, and he shall serve for one year or until he is re-elected or his successor is elected. The planning commission shall appoint a secretary who may be an officer or an employee of the governing authority or of the planning commission. The planning commission shall meet at least once each month at the call of the chairman and at such other times as the chairman or board may determine, shall adopt rules for the transaction of business and shall keep a record of its resolutions, transactions, findings, and determinations, which record shall be a public record. The planning commission may appoint such employees and staff as it may deem necessary for its work. In the performance of its duties, the planning commission may cooperate with, contract with, or accept funds from Federal, State, or local, public or semi-public agencies or private individuals or corporations, may expend such funds, and may carry out such cooperative undertakings and contracts. It may make expenditures for the purchase of required equipment and supplies. The expenditures for the purchase of required equipment and supplies. The expenditures of the planning commission, exclusive of gifts to the commission or contract receipts, shall be within the amounts appropriated for the purpose by the governing authority or authorities who are empowered to determine, agree upon, and appropriate funds for the payment of the expenses of the planning commission or their respective shares thereof.

SECTION 3

PLANNING COMMISSION: PRINCIPAL POWERS AND DUTIES. - It shall be the function and duty of the municipal planning commission, the county planning commission, or the municipal-county planning commission to make such careful and comprehensive surveys and studies of existing conditions and probable future developments and to prepare such plans for physical, social, and economic growth as will best promote the public health, safety, morals, convenience, prosperity, or the general welfare as well as efficiency and economy in the development of its political jurisdiction. In particular, the planning commission shall have the power and duty to:

1. Prepare a master plan or parts thereof for the development of its political jurisdiction.
2. Prepare and recommend for adoption to the appropriate governing authority or authorities a zoning ordinance or resolution and map for its political jurisdiction.
3. Prepare and recommend for adoption to the appropriate governing authority or authorities regulations for the subdivision of land within its political jurisdiction, and to administer the regulations that may be adopted.
4. Prepare and recommend for adoption to the appropriate governing authority or authorities, a plat or plats of an official map showing the exact location of the boundary lines of existing, proposed, extended, widened or narrowed streets, public open spaces or public building sites, together with regulations to control the erection of buildings or other structures within such lines, within its political jurisdiction or a specified portion thereof.

In addition, unincorporated areas adjacent to municipalities may be added to and included in the area under the jurisdiction of a municipal planning commission for general planning and for master plan preparation and for the preparation and administration of zoning ordinances or resolutions, land subdivision regulations, and official maps, provided that the governing bodies of the county and municipality shall agree to the boundaries of such additional areas, procedures for joint action, procedures for the adoption and administration of ordinances and resolutions, and regulations applying to the area, and the manner of obtaining equitable representation on the municipal planning commission and board of zoning appeals. Such agreement shall be formally established by appropriate official action by the governing authorities involved.

SECTION 4

PLANNING COMMISSION: MISCELLANEOUS POWERS. - The municipal planning commission, the county planning commission, or the municipal-county planning commission may make, publish, and distribute maps, plans and reports and recommendations relating to the plan and development of its political jurisdiction to public officials and agencies, public utility companies, civic, education, professional and other organizations and citizens. It may recommend to the executive or legislative officials of its political jurisdiction programs for public improvements and the financing thereof. All public officials shall, upon request, furnish to the planning commission, within a reasonable time, such available information as it may require for its work. The planning commission, its members and employees, in the performance of its functions, may enter upon any land, make examinations and surveys, and place and maintain necessary monuments and marks thereon, provided, however, that the planning commission shall be liable for any injury or damage to property resulting therefrom. In general, the planning commission shall have such powers as may be necessary to enable it to perform its functions and promote the planning of its political jurisdiction.

SECTION 5

PLANNING COMMISSION: REPORTS ON MATTERS REFERRED TO IT. - The governing authority or authorities may by ordinance or resolution provide for the reference of any matters or class of matters to the planning commission serving its political jurisdiction before final action thereon by the public body or officer having final authority thereon, with the provisions that final action thereon shall not be taken until said planning commission has submitted its report thereon or has had a reasonable time, to be fixed in said rule, to submit the report.

SECTION 6

MASTER PLAN. - It shall be the duty of the municipal planning commission, the county planning commission, or the municipal-county planning commission to make a master plan of its political jurisdiction and to perfect it from time to time. Such master plan may show, among other things; existing and proposed streets, highways, expressways, bridges, tunnels and viaducts and approaches thereto; routes of railroads and transit lines; terminals, ports, airports; parks, playgrounds, forests, reservations and other public open spaces; sites for public buildings and structures; districts for residence, business, industry, recreation, agriculture, forestry; special districts for other purposes; limited development districts for purposes of conservation, water supply, sanitation drainage, protection against floods, and the like; areas for housing developments, slum clearance, and urban renewal and redevelopment; location of public utilities whether publicly or privately owned, including but not limited to sewerage and water supply systems; zoning districts, and other planning features, together with time and priority schedules and cost estimates for the accomplishment of the proposals. The master plan shall be based upon and include appropriate studies of the location and extent of present and anticipated population, social and economic resources and problems, and other useful data. Such plan may be adopted, added to, and changed from time to time, by a majority vote of the planning commission. It shall be a public record, but its purpose and effect shall be solely to aid the planning commission in the performance of its duties.

SECTION 7

ZONING: GRANT OF POWER. - For the purpose of promoting the health, safety, morals, convenience, order, prosperity, or general welfare of the municipality or county or both, the governing authorities of the municipality and county, respectively, are hereby empowered, in accordance with the conditions and the procedure specified in this Act, to regulate the location, height, bulk, number of stories and size of buildings and other structures, the percentage of lot which may be occupied, the sizes of yards, courts, and other open spaces, the density and distribution of populations, and the uses of buildings, structures, and land for trade, industry, residence, recreation, agriculture, forestry, conservation, water supply, sanitation, protection against floods, public activities, and other purposes. Such regulations shall be made in accordance with a comprehensive plan and shall be designed to lessen congestion in the streets; to secure safety from fire, panic, and other dangers; to promote health and the general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements. Such regulations shall be made with reasonable consideration, among other things, of the character of the district and its peculiar stability for particular uses, and with a view to promoting desirable living conditions and the sustained stability of neighborhoods, protecting property against blight and depreciation, securing economy in governmental expenditures, conserving the value of buildings, and encouraging the most appropriate use of land and other buildings and structures throughout such municipality or county or both.

SECTION 8

ZONING: PLAN AND ORDINANCE. - Whenever the municipal planning commission, the county planning commission, or the municipal-county planning commission makes and certifies to its governing authority or authorities a zoning plan, including both the full text of the recommended zoning ordinance or resolution or both and the maps, for the entire area of the municipality or for the entire unincorporated area of the county or for any militia district or land lot or land or water areas 500 feet wide on either side of any State or county highway or section of such highway or land or water areas 500 feet wide on either side of any water line of a stream or water reservoir or section thereof within the unincorporated area of the county, then the governing authority of the municipality or county may exercise the powers granted to them in Section 7 of this Act and, for the purposes therein mentioned, may divide the municipality or county or above specified portions of county into districts of such number, shape and size as it may determine, and within such districts it may regulate the erection, construction, reconstruction, alteration, and use of buildings and structures and the uses of land. All such regulations shall be uniform for each class or kind of building throughout each district, but the regulations in one district may differ from those in other districts. The lawful use of any land, building, or structure that was existing and lawful at the time of the enactment or amendment of zoning regulations may, except as hereinafter provided, be continued although such does not conform with the provisions of such regulations or amendments (hereinafter called non-conforming use.) The governing authority of any municipality or county may provide in the zoning ordinance or resolution for the continuance, restoration, reconstruction, extension, or substitution of a non-conforming use. Such governing authority may also provide for the termination of any use of a building or structure or land that is not in conformity with the regulations of the district within which it is located either by specifying the period or periods in which the non-conforming use shall be required to cease, or by providing a formula or formulae whereby the compulsory termination of a non-conforming use may be so fixed as to allow for the recovery or amortization of the investment in such non-conforming use.

SECTION 9

ZONING: METHOD OF PROCEDURE. - Before enacting the zoning ordinance or resolution the governing authority of the municipality or county shall hold a public hearing thereon, at least fifteen days' notice of the time and place of which shall be published in a newspaper of general circulation in the municipality or county. No change in or departure from the text or maps, as certified by the municipal planning commission, the county planning commission, or the municipal-county planning commission, shall be made unless such change or departure be first submitted to the planning commission for review and recommendation. The planning commission shall have 30 days within which to submit its report. If the planning commission fails to submit a report within the 30-day period, it shall be deemed to have approved the change or departure.

SECTION 10

ZONING: AMENDMENTS OF ZONING PROVISIONS; HEARINGS; PROCEDURE. - The zoning ordinance or resolution, including the maps, may be amended from time to time; but no amendment shall become effective unless it shall have been proposed by or shall first have been submitted to the municipal planning commission, the county planning commission, or the municipal-county planning commission for review and recommendation. The planning commission shall have thirty (30) days within which to submit its report. If the planning commission fails to submit a report within the thirty (30) day period, it shall be deemed to have approved the proposed amendment. The provisions of the previous section relative to public hearings and official notice shall apply equally to all amendments. However, the governing authority of the municipality and the county may, by joint resolution, authorize a municipal-county planning commission to hold all the public hearings in lieu of the public hearing required by the governing authority of the municipality and county and that when so authorized by ordinance or resolution by the governing authority of the municipality and county, the Municipal-County Planning Commission shall hold a public hearing thereon; at least fifteen (15) days' notice of the time and place shall be published in a newspaper of general circulation in the county before enacting any amendment to the zoning ordinance or resolution, including the maps and that when said public hearing is held as required herein by the Municipal-County Planning Commission a public hearing by the governing authority of the municipality or county shall not be necessary before amending the said zoning ordinance or resolution including the maps thereof.

SECTION 11

ZONING: BOARD OF APPEALS. - The governing authority of the municipality or the governing authority of the county may each create a board of zoning appeals or they may create a joint board of appeals.

The board of appeals shall consist of not less than three or more than five members, appointed by the governing authority or authorities of the area served. The members shall serve for overlapping terms of not less than three or more than five years or thereafter until their successors are appointed. Any vacancy in the membership shall be filled for the unexpired term in the same manner as the initial appointment. Members shall be removable for cause by the appointing authority upon written charges and after public hearing. The appointing authorities shall determine the amount of compensation, if any, to be paid to the members of a board of zoning appeals. None of the members shall hold any other public office or position in the municipality or county, except that one member may be also a member of the planning commission.

The board of appeals shall elect one of its members a chairman, who shall serve for one year or until he is re-elected or his successor is elected. The board of appeals shall appoint a secretary who may be an officer of the governing authority or of the planning commission. The board shall adopt rules in accordance with the provisions of any ordinance or resolution adopted pursuant to this Act. Meetings of the board shall be held at the call of the chairman and at such other times as the board may determine. The chairman, or in his absence the acting chairman, may administer oaths and compel the attendance of witnesses by subponea. The board shall keep minutes of its proceedings, showing the vote of each member upon each question, or if absent or failing to note, indicating such fact, and shall keep records of its examinations and other official actions, all of which shall be immediately filed in the office of the board and shall be a public record.

Appeals to the board of appeals may be taken by any person aggrieved or by any officer, department, board, or bureau of the municipality or county affected by any decision of the administrative officer. Such appeal shall be taken within a reasonable time, as provided by the rules of the board, by filing with the officer from whom the appeal is taken and with the board of appeals a notice of appeal specifying the ground thereof. The officer from whom the appeal is taken shall forthwith transmit to the board all the papers constituting the record upon which the action appealed from was taken.

An appeal stays all legal proceedings in furtherance of the action appealed from, unless the officer from whom the appeal is taken certifies to the board of appeals after the notice of appeal shall have been filed with him, that by reason of facts stated in the certificate a stay would, in his opinion, cause imminent peril to life and property. In such case proceedings shall not be stayed otherwise than by a restraining order which may be granted by the board of appeals or by a court of record on application, on notice to the officer from whom the appeal is taken, and on due cause shown.

The board of appeals shall fix a reasonable time for the hearing of the appeal or other matter referred to it, and give public notice thereof, as well as due notice to the parties in interest, and decide the same within a reasonable time. Upon the hearing any party may appear in person or by agent or by attorney.

The board of appeals shall have the following powers:

1. To hear and decide appeals where it is alleged there is error in any order, requirement, decision, or determination made by an administrative official in the enforcement of any ordinance or

resolution adopted pursuant to this Act.

2. To hear and decide special exceptions to the terms of the ordinance or resolution upon which such board is required to pass under such ordinance or resolution.

3. To authorize upon appeal in specific cases such variance from the terms of the ordinance or resolution as will not be contrary to the public interest where, owing to special conditions, a literal enforcement of the provisions of the ordinance or resolution will, in an individual case, result in unnecessary hardship, so that the spirit of the ordinance or resolution shall be observed, public safety and welfare secured, and substantial justice done. Such variance may be granted in such individual case of unnecessary hardship upon a finding by the board of appeals that:

   (a) There are extraordinary and exceptional conditions pertaining to the particular piece of property in question because of its size, shape, or topography, and

   (b) The application of the ordinance or resolution to this particular piece of property would create an unnecessary hardship, and

   (c) Such conditions are peculiar to the particular piece of property involved, and

   (d) Relief, if granted, would not cause substantial detriment to the public good or impair the purposes and intent of the ordinance or resolution, provided, however, that no variance may be granted for a use of land or building or structure that is prohibited by the ordinance or resolution.

In exercising the above powers, the board of appeals may, in conformity with the provisions of this Act, reverse or affirm, wholly or partly, or may modify the order, requirements, decision, or determination, and to that end shall have all the powers of the officer from whom the appeal is taken and may issue or direct the issuance of a permit.

SECTION 11A

ZONING: APPEALS FROM DECISIONS OF BOARD OF ZONING APPEALS. - Any person or persons severally or jointly aggrieved by any decision of the Board of Zoning Appeals, may take an appeal to the Superior Court. Said appeal to the Superior Court shall be the same as an appeal to the Superior Court from any decision made by the Court of Ordinary and as specified in Chapter 6-2 of the Code of Georgia, except, however, that said appeal may be filed within thirty days from the date of the decision of the Board of Zoning Appeals, and upon failure to file said appeal within thirty days the said decision of the Board of Zoning Appeals shall be final. Provided, however, that on appeal said case shall be heard by the Judge of the Superior Court without a jury, unless one of the parties files a written demand for a jury trial within thirty days from the filing of the appeal.

SECTION 12

ZONING: ENFORCEMENT AND REMEDIES. - The governing authority of the municipality or county may provide for the enforcement of any ordinance or resolution adopted pursuant to the provisions of this Act by means of the withholding of building permits and occupancy permits, and for such purposes may establish and fill the position of building inspector, individually or jointly. From and after the establishment of such position and the filing of the same, it shall be unlawful to construct, reconstruct, or alter any building or other structure without first obtaining a building permit from such building inspector or to use such building or structure or any land without first obtaining an occupancy permit from such building inspector; and such building inspector shall not issue any permit unless the requirements of this Act and of any ordinance or resolution adopted pursuant to it are complied with. A violation of any ordinance or resolution adopted pursuant to the provisions of this Act is hereby declared to be a misdemeanor and, upon conviction thereof, shall be punished as provided by law. In case any building or structure is or is proposed to be erected, constructed, reconstructed, altered, converted, or maintained, or any building, structure or land is or is proposed to be used in violation of any ordinance or resolution adopted pursuant to this Act, the building inspector, municipal or county attorney, or other appropriate authority of the municipality or county or any adjacent or neighboring property owner who would be specially damaged by such violation may, in addition to other remedies, institute injunction, mandamus, or other appropriate action or proceeding to prevent such unlawful erection, construction, reconstruction, alteration, conversion, maintenance, or use; or to correct or abate such violation, or to prevent the occupancy of said building, structure, or land. Each and every day such unlawful erection, construction, reconstruction, alteration, conversion, maintenance or use continues shall be deemed a separate offense.

SECTION 13

ZONING: CONFLICT WITH OTHER LAWS. - Whenever the regulations made under authority of this Act require a greater width or size of yards, courts, or other open spaces, or require a lower height of building or smaller number of stories, or require a greater percentage of lot to be left unoccupied, or impose other more restrictive standards than are required in or under any other statute, the regulations made under authority of this Act shall govern. Whenever the provisions of any other statute require more restrictive standards than are required by the regulations made under authority of this Act, the provisions of such statute shall govern.

SECTION 14

SUBDIVISION REGULATIONS: INTENT. - The public health, safety, morals, and general welfare require the harmonious, orderly and progressive development of land within the cities and counties of the State. In furtherance of this purpose, regulation of the subdivision of land by municipal and county governing authorities is authorized for the following purposes, among others:

1. To encourage the development of economically sound and stable communities;
2. To assure the provision of required streets, utilities, and other facilities and services to new land developments;
3. To assure the adequate provision of safe and convenient traffic access and circulation, both vehicular and pedestrian, in new land developments;
4. To assure the provision of needed public open spaces and building sites in new land developments through the dedication or reservation of land for recreational, educational, and other public purposes, and

5. To assure, in general, the wise development of new areas, in harmony with the master plan of the community.

SECTION 15

SUBDIVISION REGULATIONS: PLANNING COMMISSION AS PLATTING AUTHORITY. - From and after the time the municipal planning commission, the county planning commission, or the municipal-county planning commission shall have prepared and adopted a master plan or at least the major street portion of such master plan and shall have recommended to the governing authority of the municipality or the governing authority of the county regulations for the subdivision of land within the municipality or county, respectively, which regulations shall have been adopted by the governing authority of the city or county, as provided in Section 16 below, then no plat of a subdivision within the municipality or within the unincorporated portion of the county shall be filed or recorded in the office of the clerk of the Superior Court of the county until it shall have been submitted to and approved by the planning commission and such approval entered in writing on the plat, by the secretary of the planning commission. The clerk of the Superior Court shall not file or record a plat of a subdivision which does not have the approval of the planning commission as required by this Act. The filing or recording of a plat of a subdivision without the approval of the planning commission as required by this Act is hereby declared a misdemeanor and, upon conviction, is punishable as provided by law.

SECTION 16

SUBDIVISION REGULATIONS: PROVISIONS OF REGULATIONS. - In exercising the powers granted to it by this Act, the municipal planning commission, the county planning commission, or the municipal-county planning commission shall prepare and recommend to the governing authority of the city or the governing authority of the county for adoption regulations governing the subdivision of land within the municipality or unincorporated portion of the county respectively. Such regulations may provide for the harmonious development of the municipality and the county; for the coordination of streets within subdivisions with other existing or planned streets or official map streets; for the size of blocks and lots; for the dedication or reservation of land for streets, school sites, and recreation areas and of easements for utilities and other public services and facilities; and for a distribution of population and traffic which will tend to create conditions favorable to health, safety, convenience, prosperity, or general welfare.

Such regulations may include requirements as to the extent to which and the manner in which streets shall be graded, surfaced, and improved, and water, sewers, septic tanks, and other utility mains, piping, connections, or other facilities shall be installed as a condition precedent to the approval of the plat. Such regulations may provide that, in lieu of the completion of such work and installations previous to the final approval of a plat, the governing authority of the municipality or the governing authority of the county may accept a bond, in an amount and with surety and conditions satisfactory to it, providing for and securing to the municipality or county the actual construction and installations of such improvements and utilities within a period specified by the planning commission and expressed in the bond; and the municipality or county is hereby granted the power to enforce such bonds by all appropriate legal and equitable remedies. The governing authority of the municipality and the governing authority of the county are hereby given the power to adopt and to amend such land subdivision regulations after a public hearing thereon, at least fifteen days' notice of the time and place of which shall have been published in a newspaper of general circulation in the municipality or county.

SECTION 17

SUBDIVISION REGULATIONS: PROCEDURE ON PLATS. - The municipal planning commission, the county planning commission, or the municipal-county planning commission is hereby given the authority to give tentative approval or disapproval to preliminary plats and to approve or disapprove final plats but in each case their action shall be taken within thirty days after the submission thereof; otherwise, such plat shall be deemed to have been approved and a certificate to that effect shall be issued by the planning commission on demand; provided, however, that the applicant for the planning commission's approval may waive this requirement and consent to the extension of such period. The ground of disapproval of any plat shall be stated upon the records of the planning commission. Any plat submitted to the planning commission shall contain the name and address of a person to whom notice of hearing may be sent; and no plat shall be acted upon by the planning commission without affording a hearing hereon, notice of time and place of which shall be sent by registered or certified mail to said address not less than five days before the date fixed therefor.

SECTION 18

SUBDIVISION REGULATIONS: EFFECT OF PLAT APPROVAL ON STATUS OF DEDICATIONS. - The approval of a plat by the municipal planning commission, the county planning commission, or the municipal-county planning commission shall not be deemed to constitute or effect an acceptance by the municipality or the county or the public of the dedication of any street or other ground shown upon the plat.

SECTION 19

SUBDIVISION REGULATIONS: PENALTIES FOR TRANSFERRING LOTS IN UNAPPROVED SUBDIVISIONS. - The owner or agent of the owner of any land to be subdivided within the municipality or county who transfers or sells or agrees to sell or negotiate to sell such land by reference to or exhibition of or by other use of a plat of subdivision of such land before such plat has been approved by the municipal planning commission, the county planning commission, or the municipal-county planning commission and recorded in the office of the clerk of the Superior Court in the county, shall be guilty of a misdemeanor and, upon conviction thereof, shall be punished as provided by law; and the description by metes and bounds in the instrument of transfer or other document used in the process of selling or transfer shall not exempt the transaction from such penalties. The municipality or county, through its attorney or other official designated by the governing authority of the municipality or the governing authority of the county, may enjoin such transfer or sale or agreement by appropriate action.

SECTION 20

SUBDIVISION REGULATIONS: ACCEPTANCE OF AND IMPROVEMENTS IN UNAPPROVED STREETS. - From and after the time when the platting jurisdiction of the municipal planning commission, the county planning commission or the municipal-county planning commission shall have attached by virtue of the adoption by the planning commission of a major street plan and the adoption by the governing authority of the municipality or the governing authority of the county of a set of land subdivision regulations recommended to them by the planning commission, as provided in Section 15 of this Act, the governing authority of the municipality or the governing authority of the county or other public authority shall not accept, layout, open, improve, grade, pave, or light any street or lay or authorize the laying of any water mains, sewers, connections, or other facilities or utilities in any street within the municipality or county unless such street shall have been accepted or opened as, or shall otherwise have received the legal status of a public street prior to the said attachment of the planning commission's subdivision jurisdiction, or unless such street corresponds in its location and lines with a street shown on a subdivision plat approved by the planning commission or on a street plat made and adopted by said planning commission, provided, however, that the governing authority of the municipality or the governing authority of the county may locate and construct or may accept any other street if the ordinance or resolution or other measure for such approval be first submitted to the planning commission for its review and comment; such street shall have the status of an approved street as fully as though it had been originally shown on a subdivision plat approved by the planning commission or on a plat made and adopted by the planning commission.

SECTION 21

SUBDIVISION REGULATIONS: ERECTION OF BUILDINGS. - From and after the time when the platting jurisdiction of the municipal planning commission, the county planning commission, or the municipal-county planning commission shall have attached by virtue of adoption by the planning commission of a major street plan and the adoption by the governing authority of the municipality or the governing authority of the county of a set of land subdivision regulations recommended to them by the planning commission, as provided in Section 15 of this Act, no building permit shall be issued for and no building or other structure shall be erected on any lot within the municipality or county unless the street giving access to the lot upon which said building is proposed to be placed shall be accepted or opened as, or shall have otherwise received the legal status of a public street prior to that time, or unless such street corresponds in its locations and lines with a street shown on a subdivision plat approved by said planning commission or on a street plat made and adopted by said planning commission or with a street located and accepted by the governing authority of the municipality or the governing authority of the county. Any building erected in violation of this section shall be deemed an unlawful structure, and the building inspector or municipal or county attorney or other official designated by the governing authority of the municipality or the governing authority of the county may bring appropriate action to enjoin such erection or cause it to be vacated or removed.

SECTION 22

OFFICIAL MAP: ESTABLISHMENT. - The governing authority of the municipality by ordinance and the governing authority of the county by resolution may establish an official map of the municipality or the county, respectively, showing the location of the streets, public building sites, and public open spaces theretofore existing and established by law as public streets, public building sites or public open spaces. Such official map may also show the location of the boundary lines of streets, public building sites or public open spaces on plats of subdivisions which have been approved by the planning commission. The official map may include the whole or any part or parts of the municipality or county. In the event the official map thus established does not include the whole of the municipality or county but only certain parts or parts thereof, then the governing authority of the municipality or the governing authority of the county may add to the official map by placing thereon, from time to time, the boundary lines of streets, public building sites or public open spaces which at the date of the establishment of the official map existed and were established by law as public streets, public building sites or public open spaces, or which appear on a plat which has been approved by the municipal planning commission, the county planning commission, or the municipal-county planning commission. The governing authority of the municipality or the governing authority of the county shall certify the fact of the establishment of the official map to the clerk of the Superior Court of the county.

SECTION 23

OFFICIAL MAP: PLATTING OF STREET, PUBLIC BUILDING SITE, OR PUBLIC OPEN SPACE LINES BY PLANNING COMMISSION. - From and after the time when the municipal planning commission, the county planning commission, or the municipal-county planning commission shall have prepared and adopted a master plan or at least the major street portion of such master plan, the planning commission shall have the power to make or cause to be made, from time to time surveys for the exact location of the lines of new, extended, widened, or narrowed streets in the whole or in any portion of the municipality or county and to make and certify to the governing authority of the municipality or to the governing authority of the county a plat or plats of the area thus surveyed on which are indicated the lines recommended by the planning commission as the mapped lines of future streets, street extensions, street widenings, or street narrowings.

From and after the time when the planning commission shall have prepared and adopted a master plan or at least the public building sites or public open spaces portion of such master plan, the planning commission shall have the power to make or cause to be made, from time to time, surveys of the exact location of the boundary lines of new, enlarged or diminished sites for public buildings or sites for parks, playgrounds, or other public open spaces in the whole or in any portion of the municipality or county and to make and certify to the governing authority of the municipality or to the governing authority of the county a plat or plats of the areas thus surveyed on which are indicated the locations of the lines recommended by the planning commission as the mapped boundary lines of future public building sites or public parks, playgrounds, or other public open space areas of existing sites or areas that are to be expanded or contracted.

The making or certifying of a plat by the planning commission shall not in and of itself constitute or be deemed to constitute the opening or establishment of any street or public building site or public park, playground or other public open space or the taking or acceptance of any land for such purpose.

SECTION 24

ESTABLISHMENT OF PROPOSED BOUNDARY LINES OF STREETS, PUBLIC BUILDING SITES OR PUBLIC OPEN SPACES. - From and after the time the municipal planning commission, the county planning commission, or the municipal-county planning commission shall have made and certified to the governing authority of the municipality or of the governing authority of the county a plat or plats on which are indicated the locations of the lines recommended by the planning commission as the mapped boundary lines of future street, street extensions or street widenings, street narrowings, public building sites, public parks, playgrounds or other public open space areas or of existing sites or areas that are to be expanded or contracted, the governing authority of the municipality by ordinance or the governing authority of the county by resolution may make from time to time additions to or modifications of the official map by adding thereon the plats certified by the planning commission. Before taking such action, the governing authority of the municipality or the governing authority of the county shall hold a public hearing thereon, notice of the time and place of which shall be given not less than fifteen days previous to the time fixed therefor by publication in a newspaper of general circulation in the municipality or county, and, insofar as their addresses appear in the municipal or county directory or on municipal or county record or are otherwise known to the municipal or county clerk, by registered or certified mail to the record owners of the lands on or abutting which the proposed public street, public building site, or public open space lines are located.

SECTION 25

OFFICIAL MAP: REGULATION OF BUILDINGS AND OTHER STRUCTURES IN BED OF MAPPED STREETS, PUBLIC BUILDING SITES OR PUBLIC OPEN SPACES. - For the purpose of preserving the integrity of the official map, the governing authority of the municipality or the governing authority of the county may provide by ordinance or resolution respectively, that no permit shall be issued for any building or structure or part thereof on any land located between the mapped lines of any street, public building site or public open space as shown on the official map. Any such ordinance or resolution shall provide that the zoning board of appeals, if the municipality or county has such a board or, if not, a board of appeals created for the purpose in such ordinance or resolution, upon appeal by an owner or other person having an interest in any property lying within the lines of such mapped streets, public building sites or public open spaces, from an adverse order on his application for a permit and wherein it shall appear from his sworn petition that the adoption of such official map has:

1. Interfered with the free sale or disposition of such property, thereby resulting in a potential loss to him; or
2. Deprived him of a use, otherwise consistent with the zoning laws, which he intended, bonafide, to make of his property; or
3. That, balancing the interests of the municipality or county in preserving the integrity of the official map and the interest of the owner in the use and benefits of his property, relief is required by consideration of justice and equality; then, the said board of appeals shall have the power in its discretion,

alternatively or conjunctively, to grant relief as follows:

(a) where such land is not in use, to grant the appellant tax relief, which relief, if accepted by the taxpayer, shall thereafter estop him and his successors in title for a period of five years as to any claims except for the fair value of his property upon its subsequently being taken;

(b) where the relief sought involves the construction or enlargement of a building or structure or part thereof within any such mapped lines to grant a permit for it but, in so doing, it shall have the power to specify the exact location, ground area, height, materials or construction, and other details and conditions of extent, character, and duration of the building, structure, or part thereof to be permitted;

(c) where the relief sought is freedom from interference with the free sale and disposition of such property, to order the governing authority, within not more than one hundred days, to either

  (1) institute condemnation proceedings or negotiations to acquire the property, or

  (2) permit the sale of the property free and clear of the restrictions imposed by reason of the adoption and recording of the mapped street, public building site or public open space herein referred to but subject, however, to any valid and applicable zoning

regulations. Before taking such action, the board of appeals shall hold a hearing thereon, at least fifteen days' notice of the time and place of which shall be given to the appellant in his appeal petition.

SECTION 26

DEFINITIONS. - For purposes of this Act the term "street" or "streets" means, relates to, and includes streets, avenues, boulevards, roads, highways, expressways, lanes, alleys, and other ways; "subdivision" means all divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, whether immediate or future, of sale, legacy, or building development, and includes all division of land involving a new street or a change in existing streets, and includes resubdivision and, where appropriate to the context relates to the process of subdividing or to the land or area subdivided; provided, however, that the following are not included within this definition:

1. The combination or recombination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to the standards of the municipality;
2. The division of land into parcels of five acres or more where no new street is involved.

SECTION 26A

TRANSPORTATION OF PASSENGERS FOR HIRE. - For the purpose of sections 22, 23, 24 and 25 of this Act pertaining to the platting and establishment of streets, public building sites and public open spaces, and regulation of buildings and structures therein, "streets", "public building sites" and "public open spaces" are hereby defined to include the right-of-way and facilities of or needed in connection with a system of public transportation of passengers for hire.

SECTION 27

EFFECT ON EXISTING PLANNING AND ZONING AUTHORIZATION. - This Act shall become effective upon its adoption by the governing authority of a municipality or a county, as the case might be. Any municipality which, prior to January 31, 1946, had the power and authority under its charter as originally granted or amended to engage in planning and zoning, as authorized by the Constitution of Georgia, and any municipality or county which now has the power and authority to engage in planning and zoning under the provision of an Act relating to zoning and planning, approved January 31, 1946 (Ga. Laws, 1946, p. 191), as amended, or under the provisions of any local or special Act, or under the provisions of the Constitution of Georgia may continue to operate under such law. All powers and authority granted by this Act to municipal and county and joint municipal-county planning commissions and boards of appeals shall be cumulative. Such powers and authority shall be in addition to all other powers and authority such planning commissions and boards of appeals now have or may later have under other laws.

Any county resolution or municipal ordinance legally enacted under the authority of any such statute or constitutional provision shall remain in force amd effect after this Act becomes effective until the county or municipality has brought such resolution or ordinance into conformity with the provisions of this Act. Provided, however, that after this Act becomes effective in any municipality or county, such resolutions and ordinances shall be administered under the provisions of this Act and any amendment to any such county resolution or municipal ordinance shall be made under the provisions of this Act.

SECTION 28

PUBLIC HEARINGS. - In all municipalities having a population of more than 300,000 according to the United States Census of 1950 or any future United State Census, that declare this Act to be effective, the governing authorities of any such municipality may provide for any public hearing required to be held by this Act by and before a committee of the said governing authority, and such hearing, when held, shall constitute the hearing required to be held by any provision of this Act.

SECTION 29

PUBLICATION OF NOTICES. - In all municipalities having a population of more than 300,000 according to the United States Census of 1950 or any future United States Census, that declare this Act to be effective, and in all counties having like population, coming under any of the terms of this Act, all notices of public hearings required by this Act shall be given by publishing the required notices in the manner provided by this Act in the newspapers in which the sheriff's advertisements are carried in the county in which the real estate is located. When so published, such notices shall comply with all the requirements of this Act.

SECTION 30

INVALIDITY OF PART. - If any portion or provision of this Act is found unconstitutional, such invalidity shall not affect any other portion or provisions of this Act.

SECTION 31

REPEAL OF CONFLICTING ACTS. - All laws and parts of laws in conflict with this Act are hereby repealed.

* * * * * * *

Original Act approved March 13, 1957

Amended March 17, 1958

Amended March 17, 1959

Amended March 17, 1960

Amended March 10, 1964

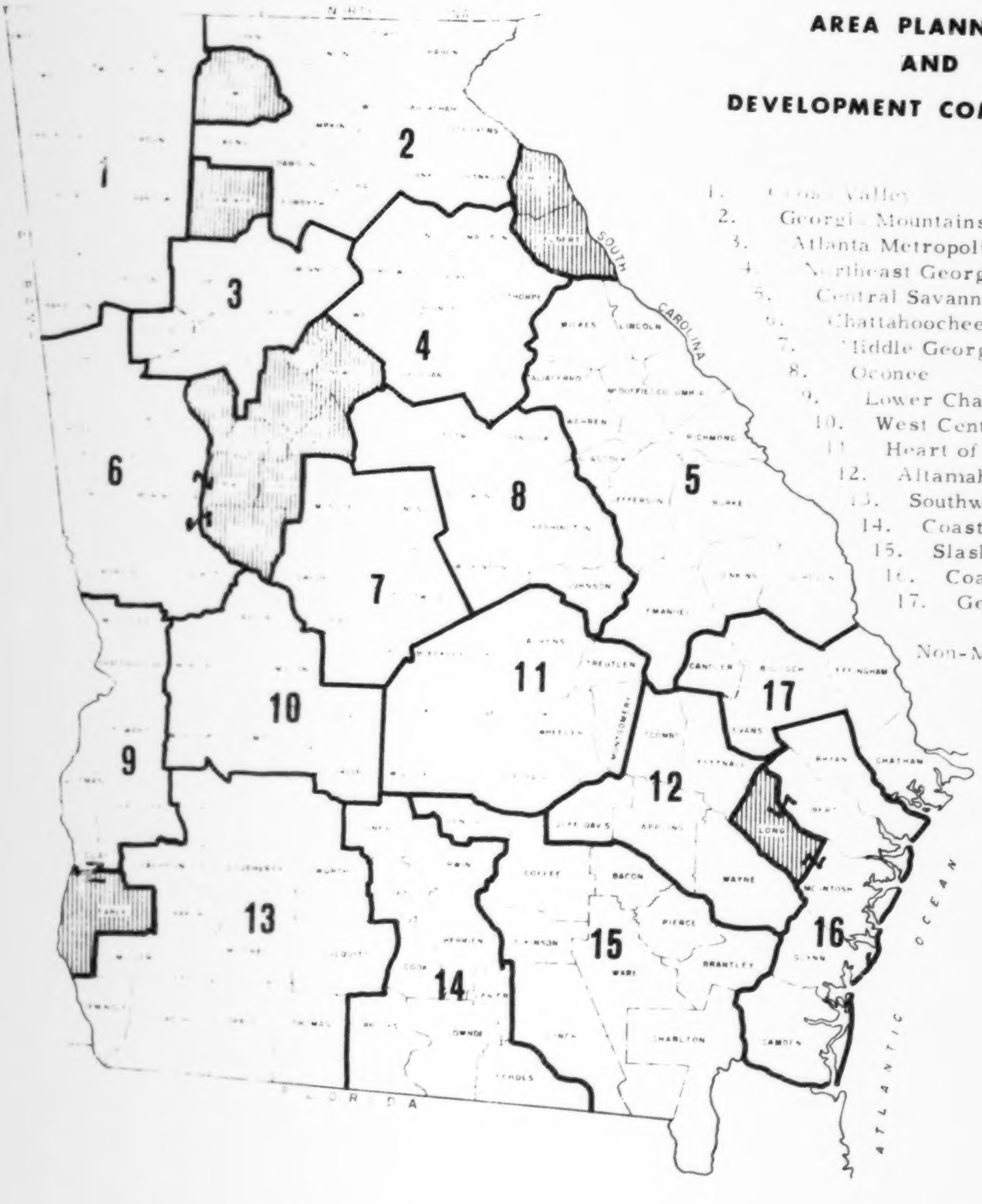
Amended April 5, 1965

Amended March 17, 1967

Amended April 14, 1967

GEORGIA

AREA PLANNING AND DEVELOPMENT COMMISSIONS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COLUMBIA
RICHMOND
JEFFERSON
BURKE
WASHINGTON
JOHNSON
JENKINS
EMANUEL
TREUTLEN
MONTGOMERY
WHEELER
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BULLOCH
EFFINGHAM
EVANS
BRYAN
CHATHAM
TOOMBS
TATTNALL
LIBERTY
LONG
JEFF DAVIS
APPLING
WAYNE
McINTOSH
COFFEE
BACON
PIERCE
WARE
BRANTLEY
GLYNN
CHARLTON
CAMDEN
BERRIEN
COOK
LOWNDES
ECHOLS
EARLY
MILLER
DOUGHERTY
WORTH
THOMAS

1. Coosa Valley
2. Georgia Mountains
3. Atlanta Metropolitan
4. Northeast Georgia
5. Central Savannah River
6. Chattahoochee - Flint
7. Middle Georgia
8. Oconee
9. Lower Chattahoochee
10. West Central Georgia
11. Heart of Georgia
12. Altamaha
13. Southwest Georgia
14. Coastal Plain
15. Slash Pine
16. Coastal
17. Georgia Southern

Non-Member Counties ▨

DEPARTMENT OF INDUSTRY AND TRADE, PLANNING DIVISION, JULY, 1966

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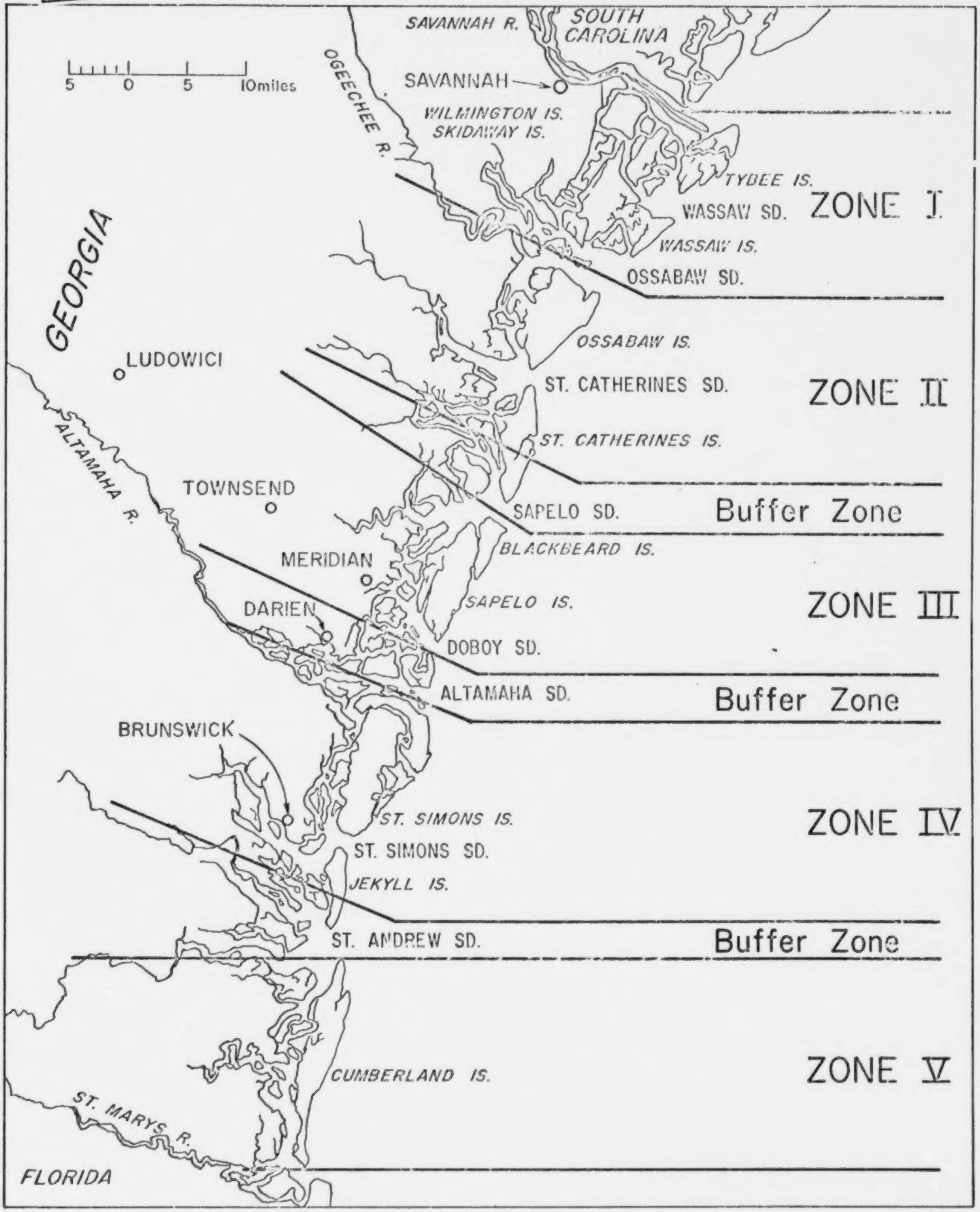
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TYBEE IS.
WASSAW SD.
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GEORGIA
OSSABAW IS.
LUDOWICI
ST. CATHERINES SD.
ZONE II
ST. CATHERINES IS.
ALTAMAHA R.
TOWNSEND
SAPELO SD.
Buffer Zone
BLACKBEARD IS.
MERIDIAN
SAPELO IS.
ZONE III
DARIEN
DOBOY SD.
ALTAMAHA SD.
Buffer Zone
BRUNSWICK
ST. SIMONS IS.
ZONE IV
ST. SIMONS SD.
JEKYLL IS.
ST. ANDREW SD.
Buffer Zone
CUMBERLAND IS.
ZONE V
ST. MARYS R.
FLORIDA

Proposed Use Zones for Coastal Georgia

NAM

National Association of
Manufacturers

February 6, 1968

Mr. John R. Thoman
Regional Director
Federal Water Pollution Control Administration
Suite 300
1421 Peachtree Street, N.E.
Atlanta, Georgia 30309

Dear Mr. Thoman:

Mr. Steinbruegge, NAM Division Manager in Atlanta, has referred to me your letter inviting the Association to present a statement at the public meeting on pollution in estuarine areas which is scheduled for February 29 in Jekyll Island.

The NAM has been active for many years in promoting the wise use of the nation's water resources both on a program and policy level, but our focus primarily has been on broad national issues. While we do appreciate your invitation, I don't feel that as a national organization we could offer meaningful data on the particular problems facing Georgia's estuarine and coastal waters.

I am enclosing for your interest a copy of the official NAM policy position on Water Quality Control which will give you an idea of our approach to this very important over-all subject.

Cordially,

Douglas Trussell
Assistant Vice President

DT:nm
Enclosure

918 Sixteenth Street, N.W., Washington, D.C. 20006
202.737-3630

OFFICIAL POLICY
POSITION OF THE NATIONAL ASSOCIATION OF MANUFACTURERS
ON
WATER QUALITY CONTROL

America's waters constitute a priceless asset as a source for public water supply, for recreation, for propagation of fish and wildlife, for navigation, and for agricultural and industrial use. We recognize the importance of the water's capacity to assimilate residual waste generated by these various uses, and we urge that such necessary assimilation be recognized in determining the uses to be made of the waters.

Great progress has already been made in preserving the quality of our waters through the efforts of state and local agencies, the cooperation of industry in modernizing its water-using and water-purifying facilities, through extensive research and development programs, and through equitable regulation by state and interstate compact agencies.

To accelerate the pace of this progress, we urge industrial management to make prompt, vigorous and continuing efforts and establish policies to:

- Keep itself and its own employees properly informed at all times on the need to control water and to maintain its quality;
- Continue and intensify its independent studies and action programs designed to prevent or alleviate deterioration of water quality at each of its own local industrial facilities;
- Encourage and assist the efforts of local, State and interstate agencies (1) to define and solve their specific water problems, (2) to establish meaningful and realistic criteria of water quality at the State or local level, and (3) to obtain adequate authority and funds to carry on effective research and control programs;
- Work with neighboring municipalities, waste treatment districts, and industries for possible joint solutions to waste treatment problems, including the construction and operation of treatment facilities capable of handling both municipal and industrial wastes;
- Work for more effective cooperation among the States on interstate problems;
- Keep the public, as well as their State and Federal government representatives and regulatory agencies, properly informed with the progress and achievements stemming from these cooperative efforts between industry and local control agencies.

The Federal government should continue its activities in basic research, data-gathering, dissemination of information, and technical advice and assistance. Where Federal enforcement actions are needed to cope with problems of state or interstate pollution, they should be conducted in harmony with the state officials involved, and with due regard to their views and recommendations. Efforts should be made by all concerned in such actions to present to the public a balanced picture of what is being accomplished as well as what remains to be done. Federal grants should be made through appropriate state agencies to public bodies, including any legally created waste treatment districts.

There are broad social benefits which accrue to all the people of the nation through water quality control efforts. Because of this and because in most instances money invested for abatement facilities does not bring an economic return, industry believes there should be some recognition of the cost of installing water quality control facilities in relation to the general public interest and the uneconomic portion of the investment.

This recognition should take the form of:

1. Accelerated amortization up to and including the immediate write-off of the facility at the option of the taxpayer; but this accelerated amortization should not eliminate the investment credit.

2. Tax credits to industrial companies.

3. Certification of the facility should rest with the state or local agency.

Industry believes that effluent taxes on discharges to waters represent an unmanageable, uneconomic and negative approach and in principle will allow polluters to continue to adversely use our waters by making a payment, which would be to the detriment of the people.

ST. SIMONS LIGHTHOUSE

St. Simons Island
Chamber of Commerce

THE YEAR ROUND PLAYGROUND
ST. SIMONS ISLAND, GEORGIA

We certify that we were appointed to serve on this committee, by the Board of Directors, of the St. Simons Island Chamber of Commerce.

We are in accord and concur with the statement regarding water pollution and abatement in the coastal waters of Georgia, as presented at this meeting by Paul Killian, Chairman.

(Signed) Preston Kirkendall
Preston Kirkendall

(Signed) J M Kent
J. M. Kent

February 29, 1968.

ST. SIMONS LIGHTHOUSE

St. Simons Island
Chamber of Commerce

THE YEAR ROUND PLAYGROUND
ST. SIMONS ISLAND, GEORGIA

STATEMENT WITH REGARD TO WATER POLLUTION AND ABATEMENT IN THE COASTAL WATERS OF GEORGIA

My name is Paul Killian, and I represent the Chamber of Commerce of St. Simons Island, Georgia;

Furthermore, I am consultant for the St. Simons Island Water & Sewer District.

We have for many years been an advocate for the abatement of pollution in our coastal waters; this interest being based on the culture of shellfish and the development of sport fishing and water contact sports.

At one period in our history the culture of oysters was of prime economic value to the area, but due to the uncontrolled entry of pollution in the area streams, this industry has been completely deleted from our economic structure. There is no future for the revival until such time as pollution of the area is brought under control.

The St. Simons Island area has primary treatment of sewage at the present time. Proposals for secondary treatment of sewage has been approved by the State Water Quality Control Board for 1970. We hope to meet the schedule.

As early as 1944, we became an advocate for the abatement of polluted waters, and quote from a statement of record at that time as follows:

> That: "The polluted areas of Brunswick and Glynn County be cleared up by the installation of necessary sewage disposal facilities."

The above statement was made in connection with Post War Plans for the area. It was then realized that pollution was going to be a menace to shellfish culture and sport fishing. Experience had shown these to be of great economic value, and furthermore, pollution abatement of our streams was to become a necessity in light of the unfavorable conditions arising from the various sources of pollution.

(Signed) Paul Killian
Paul Killian,
Committee Chairman

February 29th, 1968.

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Honorary Life Member
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University of Georgia
Athens 30601

The Garden Club of Georgia, Inc.

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1315 Buena Vista Road
AUGUSTA, GEORGIA 30904

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Gainesville
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Thomasville
MRS. CAREY WILLIAMS
Greensboro

March 6, 1968

Mr. John R. Thoman
Regional Director
U. S. Department of The Interior
Federal Water Pollution Control Administration
1421 Peachtree Street, N. E.
Atlanta, Georgia 30309

Dear Mr. Thoman:

It is in the public interest that The Garden Club of Georgia, Inc. has as a fundamental objective the desire to aid in the protection and conservation of natural resources and to cooperate with other agencies, organizations, and instrumentalities in its futherance.

Water has always been the most important mineral resource. But earth's water is becoming increasingly befouled, smelly, and repulsive through man's carelessness, disdain, greed, or ignorance of consequences of his actions upon the balances of nature.

Some sources of water pollution are long familiar - raw or poorly treated human sewage and industrial wastes pouring into streams and lakes, oil from ship spillage or sinkings fouling harbors and beaches and killing wildlife.

Recent studies showing the damage caused by estuarine pollution from agricultural pesticides and household detergents should be vigorously continued to control these problems.

Industry must be called upon to control all forms of industrial waste which pollute our lakes and streams. Harmful raising of temperature of streams in the process of development of electrical power or for other industrial uses must be prevented to maintain the natural biological status of our estuaries and other streams.

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Today with larger populations, greater need for domestic, industrial, and recreational uses, water has become one of our critical resources. Rivers, lakes, and swamps are ephemeral features of our landscape. They are homes for fish, wildfowl, and routes of migratory birds.

Use of water involves every activity of man. The time has come for extensive collaberation among many fields of science. There is no place among us for inertia, apathy, the voting down of bond issues for new sewage control or other plants and facilities, or bickering among political jurisdictions. Management of estuarine systems should be a cooperative effort of State, Federal, and local agencies.

Sincerely yours,

Katharine McConnell

(Mrs.) William C. McConnell
The Garden Club of Georgia, Inc.
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Mechanisms Maintaining High Productivity in Georgia Estuaries

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Abstract

The results of studies of the extensive, unpolluted estuaries at Sapelo Island, Georgia indicate that the following factors are responsible for high productivity: (1) ebb and flow water movements resulting from tidal action, (2) abundant supplies of nutrients, (3) rapid regeneration and conservation of nutrients due to activity of microorganisms and filter feeders, (4) three types of primary production units (marsh grass, benthic algae, and phytoplankton) which insure maximum utilization of light at all seasons, and (5) year-around production with successive crops. These factors are discussed and illustrated by data obtained by various workers at the University of Georgia Marine Institute, Sapelo Island.

INTRODUCTION

ESTUARIES ALONG THE GEORGIA COAST are characterized by a five- to seven-mile-wide complex of water, salt marsh, and small hammocks or islands that lies between the mainland and the sea islands. The salt marsh is irrigated by water moving within a network of sounds, tidal rivers, and tidal creeks. The water is shallow, being for the most part less than 10 meters in depth, and turbid due to suspended detrital material and inorganic solids.

Investigations of these extensive, unpolluted estuaries near Sapelo Island, Georgia, have been continuing since the founding of The University of Georgia Marine Institute in 1953. The Institute is operated with the generous financial support of Richard J. Reynolds through the Sapelo Island Research Foundation. Additional funds have been provided by The University of Georgia, the National Science Foundation, and the Atomic Energy Commission.

This paper is based primarily on the results of studies at Sapelo Island by full-time resident staff members and by staff members and graduate students from the University of Georgia and other campuses. The role of tidal marshes in estuarine production has been considered previously by Odum (1961).

One inevitable conclusion can be drawn from the results of these investigations. It is that these estuaries are among the most productive natural ecosystems in the world. We now estimate that the primary productivity is 2,000 g of dry organic matter/m^2/year or 10 tons of dry organic matter per acre per year

(Odum, 1961). In comparison, this rate of production is of the same order of magnitude as yields obtained from intensively cultivated crops such as rice and sugar cane. Therefore, we ask the question: "Why are these estuaries so productive?"

The productivity of estuaries, as well as the productivity of most ecosystems, is essentially dependent on the rate of primary productivity within the system or, in other words, on the amount of organic material formed as the result of photosynthesis. Thus, just as man is ultimately dependent on green plants for his food supply, so are all other heterotrophic organisms dependent on this source of energy. Therefore, the high productivity of estuaries is really a function of the rate of plant growth.

What we will consider today are five factors enabling a high rate of plant growth and consequently high productivity to be maintained.

RESULTS

Three Primary Production Units

The first factor considered is that organic material is being synthesized by three types of primary production units. These are *Spartina alterniflora*, (cord grass), benthic or "mud" algae, and phytoplankton. Each of these production units occupies a different zone within the estuary so that available light and nutrients are utilized efficiently. *Spartina* is a rooted aquatic plant growing in the intertidal zone; "mud" algae, primarily diatoms, are also found in the intertidal zone on the mud; and phytoplankton are the microscopic plants suspended in the water. Mud algae and *Spartina* photosynthesize at low tide when the intertidal zone is not covered by water. Therefore, carbon is fixed during the daylight hours over the entire estuary which includes both salt marsh and water.

Spartina, in terms of amount of organic material fixed and surface area covered, is the most important primary producer accounting for two-thirds to three-fourths of the primary production in the estuary while the mud algae contribute one-fourth to one-third. Previously, the contribution of phytoplankton was considered to be less than ten per cent.

However, recent studies by one of us (CLS) have shown that the phytoplankton may be much more important. On three days in August, the net rate of primary production by phytoplankton averaged 0.25 g $C/m^2/hr$ (Figure 1). Assuming that this rate was maintained for only 10 hours each day and that the organic material produced was 50 per cent carbon, the amount of dry organic material produced was 5.0 $g/m^2/day$. At this rate, the annual phytoplankton production would be 9 tons dry organic matter/acre.

The annual estimate is probably too high for two reasons. First, a daily rate of 5.0 gm is probably not maintained during cooler portions of the year. But additional measurements for last summer, using both carbon-14 and oxygen methods, indicate that the 5-gm estimate may be typical of production during summer months. Second, measurements so far have been made in only one tidal creek which is but a small fraction of the total area of the estuary. Thus even though the local intensity of production by phytoplankton is high, the amount of production may not be so great when the estuary as a whole is considered. On the other hand, phytoplankton may yet be especially important as a primary producer because the surface area of water exposed to sunlight is increased in the marsh at high tide.

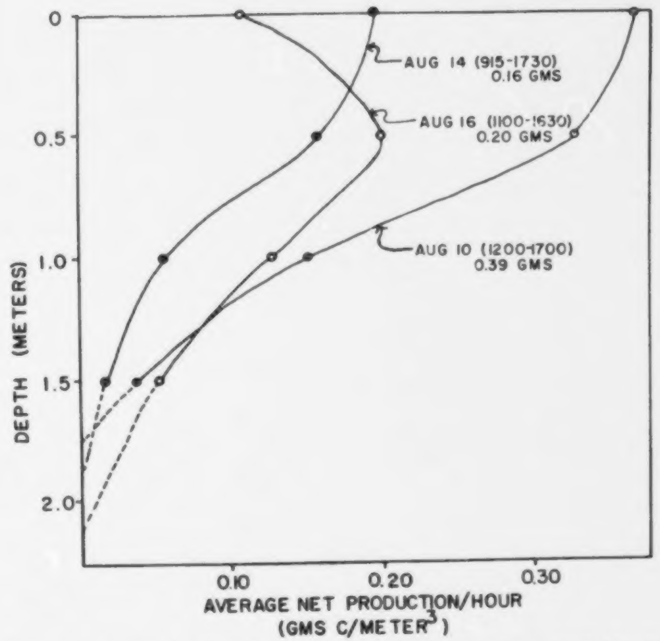

FIGURE 1. Net rate of carbon fixation determined by the oxygen method using a photosynthetic quotient of 1.25. Amount indicated for each date is the net rate of fixation/m^2/hr determined from the area under each of the three photosynthetic profiles.

The surface area at high tide may be from four to five times greater than the area at low tide (Ragotzkie and Bryson, 1955). Phytoplankton production in this water could contribute greatly to the total primary production of the estuary if it is as great as that found in the tidal creeks. As can be seen in Figure 1, most of the carbon is fixed in the upper meter of water.

Tidal Action

Tidal action is the second factor contributing to high productivity that we will consider. We have just noted that it may be an important factor in maintaining high productivity by increasing the surface area under which phytoplankton photosynthesis can occur.

The tidal amplitude at Sapelo Island has a mean range of 6.8 feet and varies from 4.5 to 10.5 feet. The resulting tidal action produces ebb and flood water movements that alternately drain and flood the salt marsh. Water movements are important because, other factors being equal, flowing water is more productive than standing water. The flooding and draining of the marsh are important in that this is the means of transporting material in and out of the marsh. We know for instance that only about five per cent of *Spartina* is consumed "on the stalk" (Smalley, 1959) so that the fate of most of the grass is transformation into detrital material by microorganisms. This detritus is transported by water in the estuary so that it may be utilized by various types of filter feeders. Currents produced by tidal action also maintain particulate material containing nutrients in suspension and transport the material within the estuary.

Abundant Supplies of Nutrients

The third factor contributing to high productivity is abundant supplies of nutrients. A high rate of photosynthesis can be maintained because nutrient supplies are abundant. Photosynthesis by algae is probably limited by factors other than nutrients. Light is undoubtedly an important factor in the extremely turbid waters. If nutrients are limiting any of the primary producers, they are limiting at a very high level of production.

Richard Williams, a graduate student from Harvard University, has been studying the ecology of mud diatoms. He has found that nutrients do not limit growth in the presence of natural water and substrate. Under experimental conditions, in the absence of the mud, growth of the diatoms can be increased by addition of nitrogen to the estuarine water. This also points to the importance of the mud and its associated biota as a source of nutrients. Nitrogen being limiting in the water agrees with results of nutrient enrichment experiments with phytoplankton by one of us (CLS) in that nitrogen addition stimulates growth under the conditions of these experiments.[1]

The abundant nutrient supplies in the estuary are not carried in by fresh-water runoff from the land. Dr. L. R. Pomeroy (personal communication) has measured the phosphorus concentrations of the inflowing Altamaha River and of the estuarine waters. The Altamaha carries only about 0.1 μg atoms per liter of dissolved inorganic phosphorus while the concentration in the estuarine water is 10 to 40 times greater. The estuarine water also has greater quantities of other forms of phosphorus and has a higher concentration of phosphorus than the coastal waters.

Conservation and Rapid Turnover of Nutrients

The fourth factor maintaining high productivity is that, in addition to being abundant, nutrients are not limiting because of their rapid turnover and their conservation in the estuary.

The high concentration of nutrients is not due to stratification which does not occur in our Georgia estuaries. Nutrients, however, may be "trapped" by the vertical mixing of waters of different salinities. Pomeroy (1960) has studied the rate of turnover of phosphorus and has concluded that it is more important in maintaining productivity than the actual concentration. A high rate of turnover means that a single atom of the nutrient can be utilized by organisms many times while a low rate of turnover means that much more nutrient is needed for the same amount of utilization to be realized.

Kuenzler (1961) has shown that the common horse mussel (*Modiolus demissus*), which is abundant in the marsh, plays an important role in the phosphorus cycle. The mussel is a filter feeder, filtering particulate material from the water and sedimenting most of the particulate material as pseudofeces. Nutrients and organic material in the pseudofeces remain in the marsh where they are available for estuarine production. Thus the mussel is an important biological agent in the biogeochemical cycling of phosphorus.

Year-Around Production

The final factor contributing to high productivity in estuaries which we will consider is year-around production with successive crops. The marsh grass produces two crops a year. The mud algae maintain a constant rate of production throughout the year in a rather unique manner. During the summer the greatest production takes place when the algae are covered by water, and during the winter the greatest production occurs when the sediments are exposed to direct sunlight (Pomeroy, 1959). Phytoplankton also produces organic matter throughout the year, but at present we have only limited data on the yearly cycle.

DISCUSSION

Data have been presented indicating that estuaries are highly productive. However, this high productivity is based for the most part on the amount of energy fixed in organic material by photosynthetic plants. Unfortunately, this does not tell us anything concerning the fate of this energy. In other words, how much of it is utilized by various components within the ecosystem? It does place an upper limit or indicates the potential for production because the energy flow through the system is governed by the amount of energy fixed during photosynthesis.

We will be able to determine the energy flow and production of the animals in the estuary when more is known about the food habits and energy requirements of the animals and when more is known about the fate of organic material produced during photosynthesis. To do this we will have to learn more about detrital material, as it seems that much of the production is channeled through this type of organic matter.

Several generalizations can be made from what we have already learned. The first of these is concerned with basic research. Even though investigators at Sapelo Island have been free to pursue their own research interests, their results have had practical applications. These practical applications, however, are sometimes difficult to predict in advance.

The second generalization is that the estuarine complex consisting of salt marsh and water should be considered as a single unit. It is the interaction between the salt marsh and the water that makes the estuaries so fertile. We are often asked: "Of what value is the salt marsh?" or "What can be done with all that wasted land?" We can now answer that the salt marsh supplies food for aquatic organisms and that the shrimp and other seafood we eat may well have ultimately been nourished by *Spartina*.

We have seen that nature has produced in the estuary an efficient means of maintaining high productivity. The estuary is fertilized and produces large quantities of organic material without any help from man. Therefore, the third generalization is that we should concentrate our efforts on the utilization of this resource, not on altering it, so that we may harvest more efficiently what is produced naturally. To do this will require more study of estuaries and a change in our way of thinking.

Dr. Odum, in this regard, has proposed that estuarine conservation districts be established so that the production of estuaries can be utilized more efficiently (Odum, 1961).

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[1] Experiments in which nutrients are added to bottles containing natural estuarine water so that the effect of the nutrients on photosynthetic C^{14} uptake can be determined.

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3. THE ROLE OF TIDAL MARSHES IN ESTUARINE PRODUCTION

by

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University of Georgia

(A New York State Conservation Dept. Information leaflet, reprinted by kind permission of the Division of Conservation Education)

Estuaries and adjacent alluvial plains are among the most naturally fertile areas of the world. In many parts of the world their productivity is important to the support of large human populations, yet strange to say, estuaries, marshes and river deltas in the United States are generally regarded as waste lands of value chiefly as convenient sewers for the dumping of the wastes of an industrial civilization. While the early settlements together with food growing and food gathering areas in North America were largely coastal, the centers of population and farming subsequently moved inland. With the rapid increase in human population now taking place, attention will again be focused on our coastal resources. The difficult problems which have already resulted from serious conflicts of interests in our culture make it mandatory that we make long-range plans based on sound principles.

The basic themes of this article are as follows : (1) Because of the importance of tidal action in nutrient cycling and production, the entire estuarine system, including marshes, flats, creeks and bays, must be considered as *one* ecosystem or productive unit. (2) Emphasis on management must be on *utilization* rather than on *production.* (3) Something akin to the soil conservation district program (i.e., estuarine conservation districts), which involves the voluntary co-operation of private and governmental interests on a *large scale*, are needed, but the " *agronomic* " approach employed in land management must be considerably *broadened* to avoid serious mistakes.

About six years ago, the University of Georgia established a Marine Institute on Sapelo Island for the purpose of conducting basic research on the estuarine ecosystem. Supported by the Sapelo Research Foundation established by R. J. Reynolds, Jr., together with funds from state and Federal sources, the vast and as yet unpolluted tidal streams and marshes are being intensively studied by a full-time resident staff supplemented by graduate students and staff members from the University of Georgia and other campuses. We hope that by the time human population pressure begins to be felt along the Georgia coast we shall have the necessary basic information to answer the inevitable questions of what should be done and where and why? Much of what I shall have to say here is based on the data obtained to date at Sapelo. We think the general principles which are unfolding are applicable throughout the Atlantic and Gulf coasts because we have been concerned with the two most basic areas of ecology; namely, the way in which energy flows in the system and the way in which vital nutrients are cycled. However, basic work of this sort needs to be done at many other points along our coast before we can be sure how far our interpretations should be carried.

A point to be emphasized is that basic work which is functional in approach is almost immediately practical. Too often in the past it has been assumed that (1) describing the standing crop, that is, enumerating kinds and numbers of organisms present, and (2) measuring the amount of certain " magic "substances such as oxygen or phosphorus present in the water will somehow provide the answers to pressing practical problems. However, description alone, no matter how detailed, does not bring understanding. If we are to know how a system works we must go beyond the " standing state " and consider the rates at which organisms, oxygen, etc., are produced per unit of time. To illustrate a little better what is meant let us consider an analogy. The Greeks described the anatomy of the human heart and blood vessels very well, but it was not until circulation was studied in the living human and animal centuries later that it was discovered how the blood system actually worked. So it is with estuarine systems—*function* as well as anatomy must be studied.

To visualize just how fertile estuaries may be, let us make some comparisons. As shown in *Table 1*, potential or " gross " production of major ecosystems of the world covers about three orders of magnitude. Many estuarine situations rank with coral reefs and intensive rice and sugar cane culture in ability to fix organic matter from sunlight. We now estimate that our Sapelo marshes and estuaries taken together have an estimated gross primary production of somewhere around 2,500 grams of dry matter per square meter per year. We think about 500 of these grams are used by the plants in their own respiration leaving about 2,000 grams net production average for each square meter of the system. It is important to recognize that there are these two kinds of production at the primary level. It is very easy to become confused because aquatic ecologists often talk about gross production while agriculturists usually deal in yields per unit time, or net production. It is also important that comparisons be made in terms of dry weights, or even better in terms of calories, of all organic matter produced per same unit of time per same unit of area!

Table 1. General Orders of Magnitude of Gross Primary Productivity in Terms of Dry Weight of Organic Matter Fixed Annually

Ecosystem	gms/M²/year (grams/square meters/year)	lbs/acre/year
Land deserts, deep oceans	Tens	Hundreds
Grasslands, forests, eutrophic lakes, ordinary agriculture	Hundreds	Thousands
Estuaries, deltas, coral reefs, intensive agriculture (sugar cane, rice)	Thousands	Ten-thousands

Returning to our estimate of 2,000 grams per square meter per year this would be approximately the same as 20,000 pounds or 10 tons of dry organic matter per acre. In terms of potential food energy usable by organisms, the net production of our estuaries is apparently of the order of 8,000 kilo-calories (since average production is about 4 calories per gram) per square meter, or about 32 million calories per acre per year! By comparison world average net production of wheat, for example, is now 340 grams/M^2/ year or about 1$\frac{1}{2}$ tons/acre/year including straw and roots as well as the grain. The highest yields of wheat and corn obtained in northern Europe, where land is tended with loving care, are around 1,400 gms/M^2/ or 7 tons/acre which is less than our estimate of 10 tons for coastal estuaries. Going in the other direction towards the sea, gross productivity of continental shelf water seems to be of the order of 300 gms/M^2/year while the open ocean is 100 grams or less. Thus, we see that estuaries tend to be more fertile than either the uplands on the one hand or the sea on the other.

At this point we should emphasize the word " potential. " The relationship of total production to " yield to man " is quite different in these various environments. More human food per acre, of course, is obtained from a wheat field than from the much more fertile estuary because only a very small fraction of the latter production reaches the human link in the food chain. If I had to single out one point for primary emphasis here it would be this : Where an environment is naturally low in fertility or has obvious limiting factors such as are present in a dry wheat field, the conventional agricultural approach of attempting to increase fertility with water, fertilizers and genetic strains is fine. However, where fertility is already high, the emphasis must shift from production to utilization.

Why are estuaries so fertile ? We can see several major mechanisms that probably are important. First, the mixing of waters of different salinities produces efficient vertical mixing that results in a sort of " nutrient trap. " Thus, valuable nutrients are not swept out but move up and down and cycle rapidly between organisms, water and bottom sediments. Secondly, the back and forth tidal flow is a favorable factor since food, nutrients and oxygen are continually supplied and waste products removed automatically with the result that organisms need not waste their own energy in these processes. Other things being equal, a flowing system will be more productive than a standing system. Certainly, in future alterations and management of estuaries we don't want to destroy or lessen the efficiency of these two mechanisms.

A persistent idea about estuaries is that inflow of river water and fertilizer washed in from the land makes an important contribution. This could well be a factor where land drainage is very rich but it is definitely not the case in Georgia. Dr. L. R. Pomeroy of our Sapelo staff has for several years now been making an intensive study of phosphorus. He has not only been measuring the amount present in both inorganic and organic form at all seasons and in various places but he has also been measuring the rate of turnover; that is, how fast phosphorus moves in and out of the major components such as organisms, sediments and water itself. In the Altamaha River just before it reaches the estuary, Dr. Pomeroy has found that the concentration of phosphorus is only about 0.1 microgram atoms per liter. This is a small amount; we suspect that at such a level phosphorus is limiting, which is to say growth will be restricted for lack of this vital element. When we reach the mouth of the river the phosphorus jumps up ten times to 1 microgram-atom. If we move to tidal creeks away from the influence of the large river the amount of phosphorus is even higher—up to 2 to 4 microgram-atoms/liter. In other words, the river, far from fertilizing the estuary, actually dilutes it with poorer water (and also mud and clay). We should also point out that the figures given refer only to dissolved inorganic phosphate which is instantly available to organisms. In addition to this, the estuaries have a tremendous reserve in particulate form—which is also available sooner or later.

Thus, we have no hesitation in saying that phosphorus is not a limiting factor in our estuary. The fact that concentrations are so much higher in the estuaries than in either the rivers or the sea is, of course, indirect evidence of the efficiency of the nutrient trap which we mentioned earlier. One of our students, Dr. Edward Kuenzler, demonstrated in his doctoral thesis that the common horse mussel (*Modiolus demissus*), which is abundant in the marshes, is extremely important in the phosphorus cycle. In filtering water to obtain its food, huge quantities of organic particles are sedimented in the form of pseudofeces which sink to the bottom; the contained materials in the particles are thus retained in the marsh and made readily available to the algae and fiddler crabs. In other words, organisms as well as salinity differences are a part of the nutrient trap. As human beings we don't eat the mussels and fiddler crabs, but they are valuable in maintaining basic fertility. Too often we justify presence of non-economic forms only on the basis that they provide food for economic animals (raccoons eat mussels, for example). Often such forms may be more ***valuable in a less direct way***, as is the mussel, ***in the maintenance of a biogeochemical cycle !***

The next thing to emphasize is that the fertility of estuaries results from the interaction of three different production units as shown in *Figure 1*. It is necessary to point this out because in classical limnology and oceanography all the emphasis is on phytoplankton (microscopic plant life in the water). This is fine for deep lakes and oceans where light does not reach the bottom. In shallow water systems, especially where much of the bottom is alternately exposed and covered by tides and fertility may be based on the rich organic composition of the bottom rather than on the phytoplankton. At Sapelo the three distinct production units may be listed as follows in order of their importance as food makers for the system as a whole : (1) The vast areas of ***Spartina*** or cord grass marshes, (2) the benthic or " mud algae " which grows throughout the intertidal sediments but especially on the creek banks and (3) the phytoplankton in the water. In another extensive shallow water estuary, Boca Ciega Bay, on the west coast of Florida, Pomeroy (1960) found that in water less than two meters deep, which constituted 75 per cent of the bay, the benthic (bottom) plants were more important, while in deeper water the phytoplankton contributed more to primary production; the shallows were equally productive whether covered by marine eel grass (*Thalassia*) or merely by benthic microflora.

The importance of the mud algae was a surprise to us. The tidal creek banks although barren of large plants are by no means deserts as they might appear at first glance. As is indicated by their green or golden brown color, the exposed sediments actually support an active community of diatoms, dinoflagellates and other algae together with associated heterotrophic micro-organisms. Dr. Pomeroy, in his studies at Sapelo, put bell jars over the mud and measured oxygen and CO_2 changes finding an unexpected high rate of production. The mud algae proved to be a beautifully adapted community which functions at about the same rate throughout the year. In summer, photosynthesis occurs mainly when the tide is in; in winter, the opposite situation holds because most photosynthesis occurs when the tide is out and the sun warms the sediments.

This mud algae business illustrates another ecological principle which we often call the " inverse size-metabolism " law. This is to say that small organisms often have a higher rate of living and production per gram of standing crop than large organisms. One pound of mud algae may produce as much food as many pounds of grass. We say that algae " turnover " more often than the grass. With large organisms such as fish, the standing crop—what is there at any one time—is indicative of production; not so with small organisms; they are exported or consumed so fast that the mass present at any one time is small. Thus, the thin film of algae in and on the mud doesn't look like anything; only when we measure rate of gas exchange do we find out its true value.

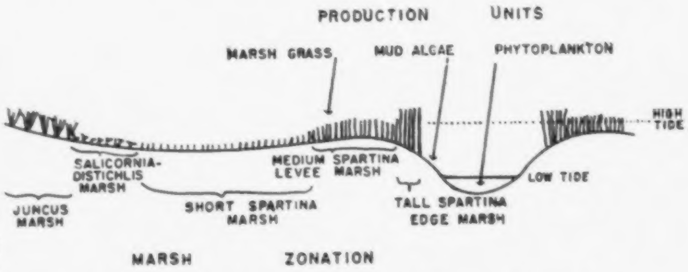


Fig. 1 -- Marsh fertility is the sum of three different production units

We suspect that in each tidal cycle some of the algae are washed into the water or " exported " and thus temporarily become a component of the plankton where they are available to filter feeders, such as oysters, throughout the estuary. It may just be that a lot of the green stuff found in the stomachs of oysters and other filter and deposit feeders is benthic in origin and not planktonic. At least in the future we should look more closely into the composition of food used by our economic species. Bottom-produced algae as well as organic detritus-bacterial particles are undoubtedly more important than formerly thought.

We now come to a third great reason why estuaries are productive, namely, a year-around crop production. We seem to have here a good example of natural homeostasis which is to say that the system tends to maintain a constant rate in a changing seasonal environment. Thus, not only do the mud algae function and produce at all seasons, but so does marsh grass and phytoplankton. The marsh grass produces at least two crops a year. In contrast, a cotton crop only grows for a few months, with zero growth for many months. The annual production of the marsh, or the estuary as a whole, may be double or triple that of ordinary agriculture simply because it grows twice or three times as long. Even in northern latitudes we suspect production by microflora may occur when land plants are inactive. And remember that the estuary fertilizes itself, plants and harvests several different crops without the human labor that would be needed to produce a multiple crop on land!

Since determining total ecosystem productivity is such an important first step in the understanding of any environment, it would be well to review methods of measurement. Much work needs to be done. The future student in this field must be much better trained in physics, chemistry and radiology than are most of us in the present generation. The possibilities opened by development of radioisotope tracer technics have scarcely been touched on the environmental level, but such technics must be approached with caution by well-trained people. There is no sharp line between the good and the bad in regard to radio-active wastes. In tracer amounts such wastes can be useful in that they provide tools to tell us what goes on.

To close out the discussion I would like to reemphasize two big points. As our work at Sapelo has made crystal clear, we must consider the entire estuary—the sounds, creeks, mud and sand flats, the marshes—as *one unit*, regardless of whether it is one or one hundred miles wide. The marshes, for example, clearly produce an excess of organic matter over what is used in the marsh, and this excess is exported into the water where it is used by the rich life there. Another of our former students, Dr. Alfred E. Smalley, obtained some good data on this point in connection with his doctoral thesis. He found that less than 5 per cent of the net production by *Spartina* marsh grass is consumed " on the stalk " as it were, by insects and other eaters of or grazers on growing grass (Smalley, 1959; Odum and Smalley, 1959). The high salinity and fierce tidal action seems to provide a natural insecticide! Even grass eaten by the salt marsh grasshoppers is not all lost because two-thirds of what the grasshopper ingests passes through the alimentary canal undigested and becomes part of the detrital export. Who knows but what grasshopper feces may even be included in food of shellfish!

Most of the tremendous production of salt marshes is destined to be used in the form as organic detritus. As grass dies and falls into the water (and this process goes on continually) the abundant micro-organisms convert it into particles rich in bacterial and algae growth and full of proteins, carbohydrates, and vitamins. This organic detritus is then distributed throughout the system.

When the average citizen looks at the vast green marshes of the southeast he is likely to regard them as wastelands because he sees no direct use by man, when, as a matter of fact, he is looking at an important source of sea food!

Unfortunately, too many so-called conservationists and engineers also view these estuarine environments as would a dry land farmer. On land, production and harvest occurs all on the same spot; in tidal estuaries there is a constant transport system which results in the separation of production and utilization in both time and space. By analogy we could think of the marshes, and probably also the mud and sand flats, as the great " wheat fields " which feed the teeming " cities " of fish and other organisms living in the creeks and sounds. The point of all this is that if we decide to spend a lot of money to dike off the marshes and make lettuce fields out of them, then we must figure on the loss of much of the energy which supports the sea food. In America I believe we need high quality, protein-rich sea food more than we need more lettuce grown at heavy tax-payer expense! We have plenty of land for land crops without converting potentially more useful wetlands.

The best approach is probably to think of the estuarine situation as a gradient. One such gradient is shown in *Figure 1* and another sort of two-dimensional gradient is shown in *Figure 2*. The kinds of plants and animals change as one goes from land or fresh-water to the sea, but the principles of ecology do not change. As already emphasized the entire gradient must be considered as a single or, at most, as two or three major functional units.

As far as management is concerned, drainage and cultivation of land or semi-aquatic crops can be considered at the far " left end " of the chart (*Figure 1*). In the middle of the gradient diking, drainage and large scale modifications are to be approached with caution. A few years ago a man was awarded a prize for draining a salt marsh and producing a large crop; the next year, as the area continued to dry out, the accumulated sulfates turned into sulfuric acid and the area became an absolute desert (this is the " cat clay " situation)! It appears that the early rice culturists in the southeast were lucky in their use of brackish and salt marsh areas because their drainage systems were inefficient! Better mechanical engineering, it turns out, would have produced biological disaster.

Towards the " right end " of our gradients where *Spartina* grasses, marine grasses, mud algae, and phytoplankton are king, it is clear that utilization of existing productivity is in order; not conversion at great expense to some other unadapted system. The strongly intertidal portion of estuaries should be considered in terms of " marine farming " and not in terms of land farming.

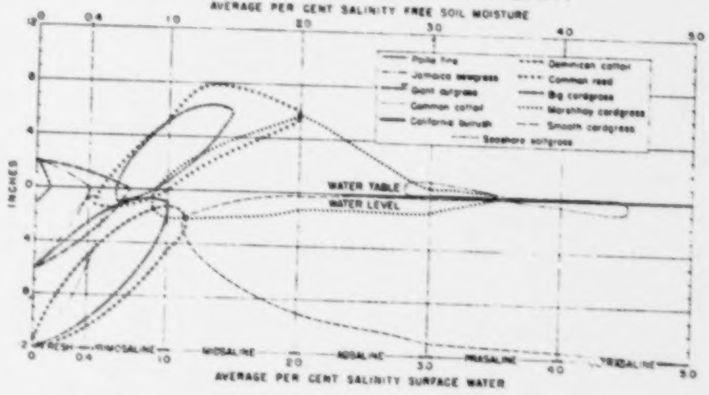
Now for the final consideration which brings us back to the principle theme of this article; namely, the need to learn more about the utilization of natural estuarine fertility. In marine ponds of the Philippines as much as 3 per cent of primary production is harvested as fish (Hickling, 1948). Starting with a primary production of 10 tons/acre/year this would amount to 600 pounds dry, or over 1,200 pounds wet, weight per year. Such a yield-to-man may seem small in comparison with the 10 to 20 per cent conversion of corn to hogs in the most efficient mid-west agriculture. The two, however, are not directly comparable because a lot of fertilizer, machines and human labor are involved in the corn-hog system which are not needed in the estuarine system. Also, harvest in estuaries involves carnivores (flesh eaters) as well as herbivores (plant eaters). At present, of course, on our Atlantic coast we harvest only a very small part of one per cent of primary production. If we obtained 1 or 2 per cent in sea food, that would be excellent.

As already stressed, the problem is that we do not know enough about how energy flows in the system. Since there are at least three very different primary crops, all interrelated, there follows a large number of different consumer energy flows. Because of this great diversity, getting a large harvest is difficult, yet this very diversity contributes a great stability—an attribute we don't want to destroy!

One thing is certain; we must avoid one-crop harvest systems. Concentrating only on oysters, or crabs, or shrimp or one species of fish can only lead to boom and bust economy in a diverse system such as an estuary. Sooner or later disease or an unfavorable season will hit any particular item in the system. There is little man can do about such. However, such species catastrophes rarely effect the ***total productivity of the system as a whole***; the accumulated energy simply goes into some other form. I even suspect that excessive pressure of specialized fishing may produce enough stress on a population to " encourage Nature to try another energy path " as it were! In any event we should be prepared with gear, know-how and markets to utilize all possible crops, and we should be prepared to vary the pressure from year to year depending on what crop is abundant.

MARSH PLANTS

APPROXIMATE RANGES OF SPECIES DOMINANCE IN RELATION TO WATER AND SALINITY



Clearly, then, two courses are open to us if we desire more from our estuaries; we can try simplifying the food chain so as to channel more energy into the most readily harvestable products, or we can learn how to harvest what comes naturally. I believe we will need to do a little bit of both; it will be dangerous to push either approach to an extreme. Too great a simplification may destroy the self-fertilizing and transport systems and bring boom and bust; too great a diversity makes harvest difficult.

Nowadays, of course, we are observing a lot of changes in estuaries which are not based on biological considerations. In many cases conservationists are not asked to evaluate the consequences until after the change has been made!

changes necessary for navigation, for example, are not necessarily bad, especially if biological as well as physical aspects can be considered. We need to think more in terms of *biological engineering*. The engineer won't understand us if we talk in terms of Latin scientific names or purely biological jargon. If we talk in terms of energy flows, calories, imports and exports or balance sheets he will not only understand us but he might even consider our suggestions!

Above all, some sort of unified planning is overdue. " Estuarine conservation districts " established for areas having a natural unity is one answer. These could be modelled after the highly successful soil conservation district program with the stipulation that persons trained in aquatic and wetland ecology be involved on the technical side, and not persons trained only in conventional agriculture. In this way an individual marsh owner could be advised what is best not only for his property but for the region as a whole. Another possibility, of course, would be to establish a sort of TVA of estuaries.

To sum up, we have hit upon the following major points : (1) Estuaries are among the most naturally fertile areas of the world because of efficient nutrient exchange, flowing water, accessibility to light and year-around primary production. (2) In such fertile systems the emphasis for both study and management should be on utilization as well as production, and the approach must be functional, not merely descriptive. (3) Coastal laboratories for basic work, preferably tied in with graduate schools, are greatly needed for both training and research. Applied as well as pure research starts from the same basic ecological principles. (4) Because of the great importance of exports and imports and the diversity of production and consumption units, the entire estuary must be considered as a whole. (5) Size of standing crop of small organisms is no indication of function; inconspicuous algae growing on exposed mud and sand areas may fix as much energy on an area basis as phytoplankton or inter-tidal marsh grass. (6) One-crop harvest procedures can only result in boom and bust economy in naturally diverse systems; increased yield for man can be obtained not so much by attempts to increase primary production as by multiple harvest of whatever develops and/or channeling energy flow into desired components. (7) There is great need to think in terms of biological engineering if we are to cope with proposed manmade alterations which originate from other than biological motives. Establishment of " estuarine conservation districts, " in which private and governmental interests cooperate, are urgently needed if the pitfalls of narrow " agronomic " thinking are to be avoided.

RÉSUMÉ

Le rôle des marais côtiers dans la productivité des estuaires

1. Les estuaires sont parmi les milieux naturels les plus fertiles de la terre grâce à l'efficacité des échanges de matière organique, grâce au mouvement des eaux, grâce à leur exposition à la lumière et grâce à la continuité, au cours de l'année, de la production de matière organique primaire.

2. Quand on étudie des milieux aussi fertiles pour les « mettre en valeur », on devrait avoir en vue non seulement la productivité naturelle des écosystèmes, mais surtout leur utilisation éventuelle. La recherche devrait être plus « fonctionnelle » que descriptive.

3. On manque autant pour l'enseignement que pour la recherche de laboratoires côtiers destinés à des études fondamentales, en liaison de préférence à des facultés. La recherche pure et la recherche appliquée partent des mêmes principes écologiques fondamentaux.

4. Les divers milieux qui composent un estuaire doivent être considérés comme un tout, à cause de l'importance des échanges de matière des uns aux autres et de la diversité des processus de production et de consommation.

5. L'importance de la biomasse ne fournit pas, chez les petits organismes, d'indication sur la productivité de ces derniers; des algues à peine visibles qui croissent sur la vase ou sur le sable, peuvent fixer autant d'énergie par unité de surface que le phytoplancton ou les herbes qui croissent dans la zone de balancement des marées.

6. Les monocultures ne peuvent à la longue que réduire la productivité de milieux aussi diversifiés. Un accroissement de la production utile à l'homme ne doit pas être recherché dans une augmentation de la productivité primaire mais bien plutôt dans la récolte de tous les produits divers qui se développent ou en canalisant le flux d'énergie vers la production des composants les plus souhaitables.

7. Si nous devons lutter contre des projets de bouleversements qui tirent leur origine de motifs non biologiques, il nous est indispensable d'acquérir une mentalité d'ingénieur biologiste. Si nous devons éviter le piège des conceptions agronomiques à courte vue, il est urgent de créer dans les estuaires des zones réservées, avec la coopération des intérêts privés et publics.

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Particulate Organic Detritus in a Georgia Salt Marsh–Estuarine Ecosystem

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In Georgia estuaries which are dominated by *Spartina alterniflora* marshes, organic detritus is the chief link between primary and secondary productivity, because only a small portion of the net production of the marsh grass is grazed while it is alive. The major energy flow between autotrophic and heterotrophic levels is by way of the "detritus food chain", rather than through the "grazing food chain" (Odum, 1962, 1963; Odum and de la Cruz, 1963; Teal, 1962). Seven aspects of detritus are being studied in the extensive salt marshes and estuaries that lie between Sapelo Island and the mainland of Georgia: (1) the seasonal picture of the standing crop of detritus in the water of tidal creeks; (2) the distribution of size and the composition of detritus particles; (3) the tidal transport of detritus in and out of a ten hectare

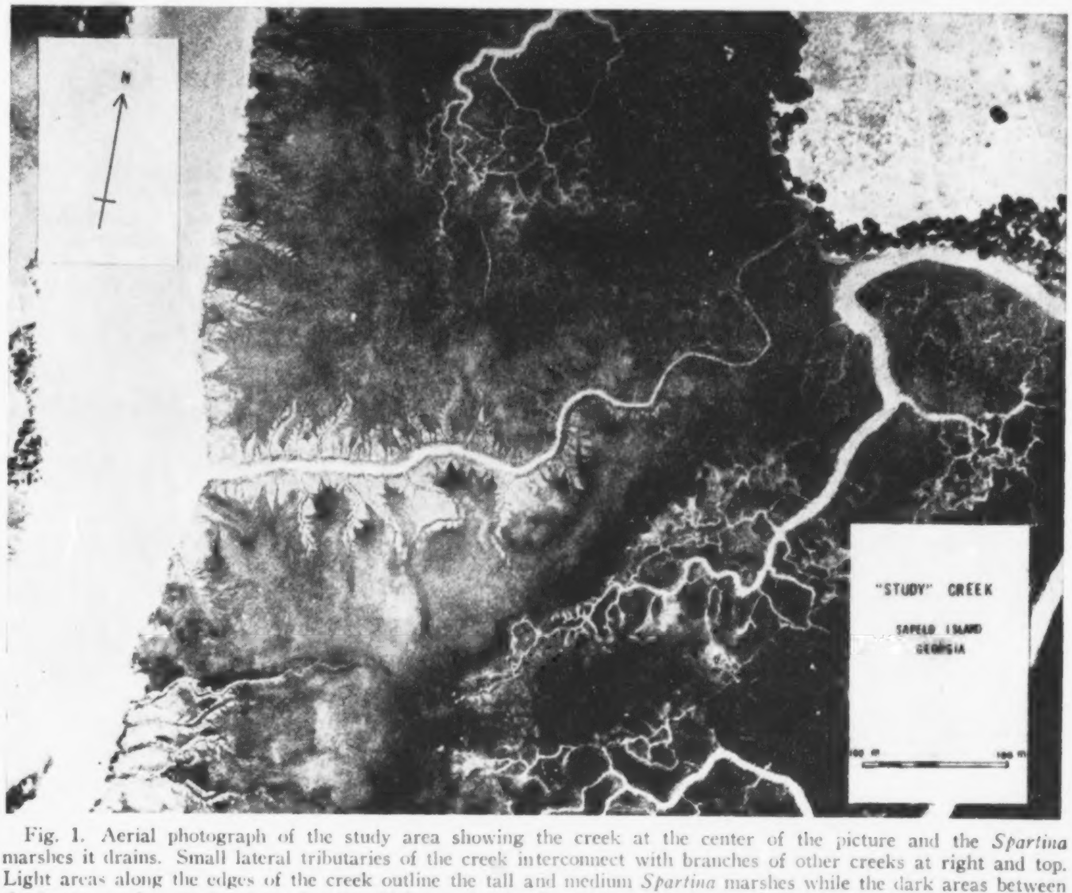


Fig. 1. Aerial photograph of the study area showing the creek at the center of the picture and the *Spartina* marshes it drains. Small lateral tributaries of the creek interconnect with branches of other creeks at right and top. Light areas along the edges of the creek outline the tall and medium *Spartina* marshes while the dark areas between the larger creeks are the short *Spartina* high marsh. At the left of the picture is the Duplin River, a large tidal channel running parallel to Sapelo Island, a small portion of which may be seen at the top right corner.

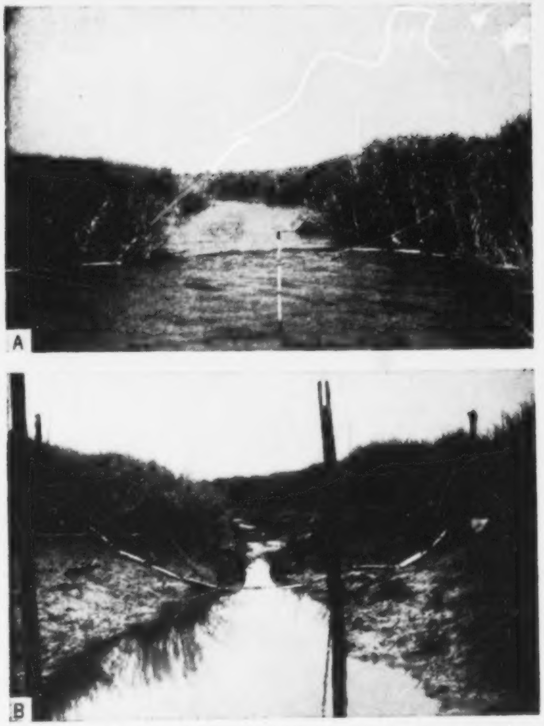


Fig. 2. Mouth of the tidal creek study area, showing tall *Spartina* grass at high (A) and low (B) tide levels during a neap tide. During spring tides, the creek is almost dry at low water and the tall grass is practically submerged at high water. The temporary weir seen across the creek was used to trap dead floating *Spartina* stalks to determine net transport of large floating organic detritus. The main sampling station is located in the immediate foreground.

marsh area which is drained by a single small creek; (4) the origin of the particles; (5) the decomposition of marsh grass in nylon "litter bags" placed at different tide levels in the field; (6) the nutritive values of different age and size components; and (7) the metabolism of detritus particles. The principal study area is shown in the aerial photograph of Figure 1. The mouth of the main creek under study, the tall *Spartina* grass, and the high and low tide levels under neap tidal conditions are shown in Figure 2. The chief sampling station was located just outside the temporary weir shown in the foreground of Figure 2.

METHODS

Suspended particles were separated into size classes in this way: known volumes of water were strained successively through a No. 6 plankton net (74 meshes/inch; 0.239 mm aperture), a No. 25 net (200 meshes/inch; 0.064 mm aperture), and a HA millipore filter. Particles retained by the No. 6 net were labeled "coarse fraction", particles strained by the No. 25 net, "fine fraction", and particles collected by the membrane filter, the "nanno fraction". Dry weight and ash-free dry weight (loss on ignition at 550° C. after one hour) were determined for each fraction. The number of particles (counted in a 45 × 45 × 10 mm chamber with 5 mm² grids) was also determined for the net fractions. The metabolic rate of detritus samples was determined in the laboratory as follows: net fractions were resuspended in millipore-filtered water while the filtrate was saved for the nanno fraction. All three fractions were collected on millipore filters which were then placed in filtered water in 300 ml bottles. After shaking to redisperse particles, the bottles were incubated in the dark at 29.5, 19.5, and 9.5° C. (representing the range of seasonal temperature of the study area) for 6, 12, and 18 hours respectively. Dissolved oxygen consumption was determined by the Winkler method.

To obtain an estimate of the exchange of detritus between the marsh and the tidal creek (Figs. 1 and 2), water samples were collected at the mouth of the creek every hour for 12 hours starting at either high or low slack water. It was estimated that the creek drains ten hectares of marsh at neap tidal levels and 24 hectares at spring tidal levels. Current velocity measurements and cross-sectional area of the creek were estimated as a basis for calculating exchange of detritus between the marsh and the estuarine creek system.

The decomposition rate of four species of marsh plants was determined by enclosing plant samples in litter bags of nylon net (2.5 mm mesh) which were placed at various tide levels in the marsh.

The successive decomposition stages of *Spartina* grass collected in the field for nutritive analyses were: living *Spartina*, dead standing, floating dead, decomposed samples in litter bags, and coarse, fine, and nanno fractions of suspended detritus. The analyses were carried out by Law and Company, Atlanta, Georgia.

Table 1. Suspended particulate detritus in mg dry weight per liter at mid-tidal levels at the mouth of a small tidal creek draining a *Spartina* salt marsh at Sapelo Island, Georgia. Each is based on two samples taken on different days.

Season	Tide levels	Spring Total	Spring Ash-free	Neap Total	Neap Ash-free
Summer	Mid-flood	35.44	6.59	21.28	5.12
	Mid-ebb	112.41	20.75	32.47	6.59
Fall	Mid-flood	41.72	7.36	24.80	6.72
	Mid-ebb	110.32	16.50	57.92	13.54
Winter	Mid-flood	29.82	5.68	10.68	1.99
	Mid-ebb	71.77	10.10	36.91	3.90
Mean	Mid-flood	35.66	6.54	18.92	4.61
	Mid-ebb	98.17	15.78	42.43	8.01

RESULTS

Standing Crop and Size Distribution of Detritus

Table 1 compares the standing crop of suspended particulate matter at mid-flood and mid-ebb tidal levels. The greater amount at the mid-ebb level at all seasons is indicative of the net export of detrital material from the marsh, especially since the velocity of the water is greater at the mid-ebb than the mid-flood level.

The standing crop of 2–20 mg ash-free dry organic matter per liter is much greater than that reported for open sea water, or such fertile locations as Plymouth Bay and Long Island Sound, where particulate organic matter is approximately 1–3 mg/l (Armstrong and Atkins, 1950; Riley, 1959; Corner, 1961; Cowey and Corner, 1963).

We do not yet have sufficient data to determine the extent of seasonal differences. We can say, however, that organic detritus is being produced and exported at all seasons.

The percentage of organic matter content of the various fractions photographed (Fig. 3) revealed that coarse, fine, and nanno fractions made up 1, 4, and 95 percent respectively. It appeared then that the highly decomposed, unrecognizable nanno fraction might be of the greatest importance.

COMPOSITION AND ORIGIN

Microscopic analysis of net seston composition revealed a high percentage of detritus particles. The mean values (Table 2) showed that about 90 percent of total seston was net detritus and only about 10 percent net plankton. More organic detritus was present during the mid-ebb flow which, again, strongly suggested a net export of organic material to the estuarine system. Plankton density was also greater at mid-ebb than mid-flood even though the percentage composition was lower (Table 2), indicating that the marsh was exporting plankton, but not as much as detritus. Much of the phytoplankton coming out of the marsh may be of benthic origin (Williams, 1962). The ratio of zooplankton to phytoplankton (in terms of numbers) was approximately 1:3 at mid-ebb and 1:4 at mid-flood.

Even though the total seston is much lower in most coastal seas, and especially in the ocean, than in Sapelo estuaries, detritus seems to make up a large percentage of seston in marine waters in general (Krey, 1961; Riley, 1963; Strickland, 1963).

Table 3 gives three estimates of the percentage of net detritus originating from *Spartina*, algae, and animals. Almost 95 percent of these larger suspended particles originated from decaying *Spartina* grass. Algal detritus consisted mostly of broken pieces of large diatom shells and dinoflagellate cases. Animal detritus included fragments of crustacean integument, pieces of chitinous appendages, fragments of molluscan shell, scales of fish, fecal pellets, shells of ostracods and foraminiferans, pieces of insect wings, bits of mammalian hair, bird feathers, etc.

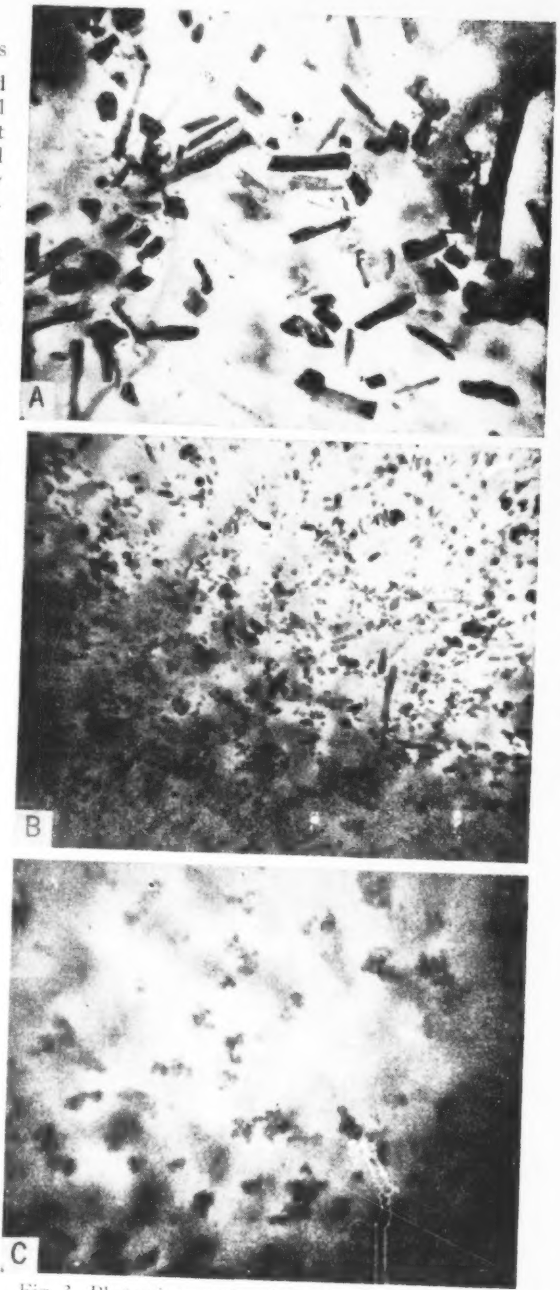


Fig. 3. Photomicrographs of detritus particles collected from the salt marsh tidal creek. A—"Coarse Detritus" collected with a coarse net (74 meshes/inch; 0.239 mm aperture), approximately 90×. B—"Fine Detritus" collected with an extra fine net (200 meshes/inch; 0.064 mm aperture), approximately 70×. C—"Nanno Detritus", aggregates of highly decomposed particles sedimented from water previously strained through the extra fine net, approximately 80×.

Table 2. Numerical composition of net seston in estuarine waters collected at the mouth of a small tidal creek at mid-tidal levels.

Dates	Tidal level	Total number seston particles per liter	Detritus		Phytoplankton		Zooplankton	
			No./l	%	No./l	%	No. l	%
6/20/63	Mid-flood	3,148	2,984	94.8	104	3.3	60	1.9
	Mid-ebb	28,653	28,452	99.3	115	0.4	86	0.3
7/3/63	Mid-flood	1,625	1,378	84.8	219	13.5	28	1.7
	Mid-ebb	5,411	5,065	93.6	271	5.0	76	1.4
7/29/63	Mid-flood	1,805	1,518	84.1	218	12.1	69	3.8
	Mid-ebb	7,242	6,952	96.0	217	3.0	73	1.0
9/26/63	Mid-flood	1,169	960	82.1	134	11.5	75	6.4
	Mid-ebb	2,928	2,293	78.3	477	16.3	158	5.4
10/1/63	Mid-flood	18,128	16,170	89.2	1,722	9.5	236	1.3
	Mid-ebb	71,196	69,914	98.2	1,068	1.5	214	0.3
11/22/63	Mid-flood	5,258	4,950	94.5	267	5.1	21	0.4
	Mid-ebb	32,264	31,554	97.8	387	1.2	323	1.0
Mean	Mid-flood	5,185	4,660	89.9	444	8.5	81	1.6
	Mid-ebb	24,615	24,038	97.7	422	1.7	155	0.6

TIDAL TRANSPORT

Smoothed curves (Fig. 4) are typical of a number of measurements of tidal transport for both spring and neap tides. As would be expected, spring tide transport of water, total particulate matter, and ash-free organic matter greatly exceeded that of neap tide. The maximum rate of discharge from the marsh occurred at the mid-ebb level, which was about 2–3 hours after the high slack water.

A preliminary calculation, based on data in Figure 4, resulted in an estimated net export of about 140 kg and 25 kg of organic matter for spring and neap tides, respectively, from the 10–25 hectare marsh area in one tidal cycle.

DECOMPOSITION OF MARSH PLANTS

Figure 5 traces the rate of decomposition of four species of marsh plants and, for comparison, decomposition of animal biomass (Fiddler crabs, *Uca pugnax*). The curves are based on the mean weight loss of two litter bags for *Distichlis, Juncus,* and *Salicornia,* nine bags for *Spartina,* and three bags for *Uca.* The litter bags were staked down in the marsh at the same tidal levels, where each species occurred naturally. After 300 days, residues expressed as the percentage of initial dry plant tissue were: *Distichlis* – 47 percent, *Juncus* – 65 percent, *Salicornia* – 6 percent, and *Spartina* – 42 percent. *Uca* decomposed completely after about 180 days in the field.

It may be pointed out that "dead standing" plant material was placed in the bags to simulate the stage when the detritus formation begins in nature. The decomposition curves indicate the rate of release into the water of soluble material and particles small enough to pass through the 2.5 mm mesh nylon litter bags.

NUTRITIVE VALUE OF DETRITUS

The percentage of protein, fat, crude fiber, and nitrogen-free extract of *Spartina* grass and detritus are compared in Figure 6, as a preliminary analysis based on single large pooled samples of each item. Although the small suspended particles were 70–80 percent ash, the organic matter in them proved to be rich in protein, up to 24 percent on an ash-free basis as compared with 10 percent in living grass and 6 percent in dead grass, as it enters the water. A buildup of microbial populations is presumed to account for the enrichment of decomposing *Spartina.* Thus, detritus rich in bacteria may be a better food source for animals than the grass tissue that forms the base for most of the particulate matter.

METABOLISM OF DETRITUS

The results of oxygen consumption measurements of the three size fractions of detritus at three temperatures are summarized in Figure 7. The 9.5 to 29.5° C. range approximates the seasonal range of temperatures in Sapelo waters. Milliliters of O_2/hr were calculated in terms of fresh weight of detritus and ash-free dry weight (i.e., actual organic matter). Analysis of variance indicates that both size and temperature have a highly significant effect on the weight—specific oxygen consumption. The rate of oxygen consumption of nanno detritus proved to be five to six times greater than that of coarse net detritus. A rate of metabolism of 10 ml O_2/gm ash-free dry weight is comparable to the respiration rate of zooplankton. The results of the metabolism measurements provide further evidence of the importance of microbial activity in determining the important role played by detritus in the ecology of estuaries. The suspended particles are by no means "dead" or "inert" bodies, and the detritus particles and the attendant microorganisms make up a highly active heterotrophic micro-ecosystem.

SUMMARY

Estuaries in Georgia dominated by *Spartina alterniflora* marshes have organic detritus as the chief link between primary and secondary productivity, since only a small portion of the net production of the marsh grass is grazed while it is living. Seven aspects of detritus are being studied at the University of Georgia Marine Institute at Sapelo Island: (1) the seasonal picture of the standing crop of detritus in water; (2) size distribution and composition of detritus particles; (3) tidal transport of detritus in and out of a ten-hectare marsh area drained by a single small creek; (4) origin of the particles; (5) decomposition of marsh grass in nylon litter bags; (6) nutritive values of different age and size components; and (7) metabolism of detritus particles.

In creeks draining Sapelo marshes, organic detritus ranges from 2 mg/l at mid-flood tide to 20 mg/l at mid-ebb tide, and makes up about 90–99 percent of the total seston. The small suspended particles are 70–80 percent ash, but the organic portion is rich in protein, up to 24 percent on an ash-free basis, as compared with 10 percent in living grass and only 6 percent in dead grass as it enters the water. Oxygen consumption (B.O.D.) per gram is more than five times as

Table 3. Percentage of detritus particles originating from three major sources as determined by microscopic examination of three samples of the net fractions strained from tidal creek water.

Date	Tidal level	*Spartina alterniflora* (Macrophytic) (%)	Algae (Macrophytic) (%)	Animals (Zooic) (%)
6/20/63	Mid-flood	97.7	2.0	0.3
7/3/63	Mid-ebb	90.5	7.6	1.6
7/26/63	Mid-ebb	93.4	4.5	2.1
Mean		93.9	4.8	1.3

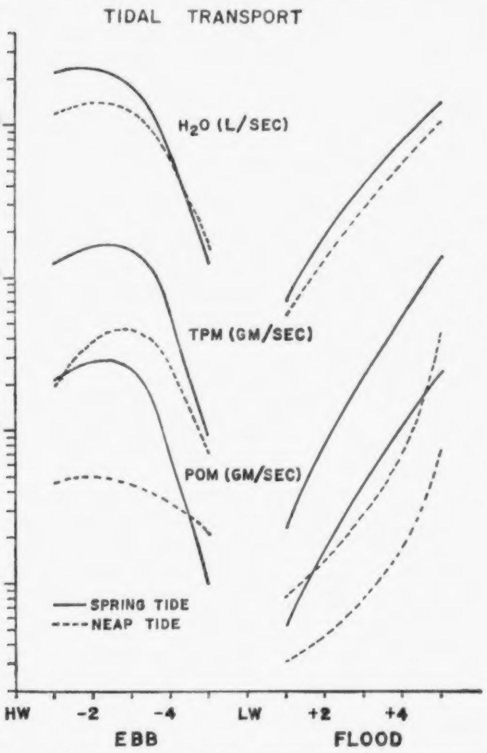


Fig. 4. Comparison of tidal transport during spring and neap tidal phases. Abscissa represents hours of tidal cycle after high water (HW) to and after low water (LW). TPM = Total particulate matter, POM = Particulate organic matter.

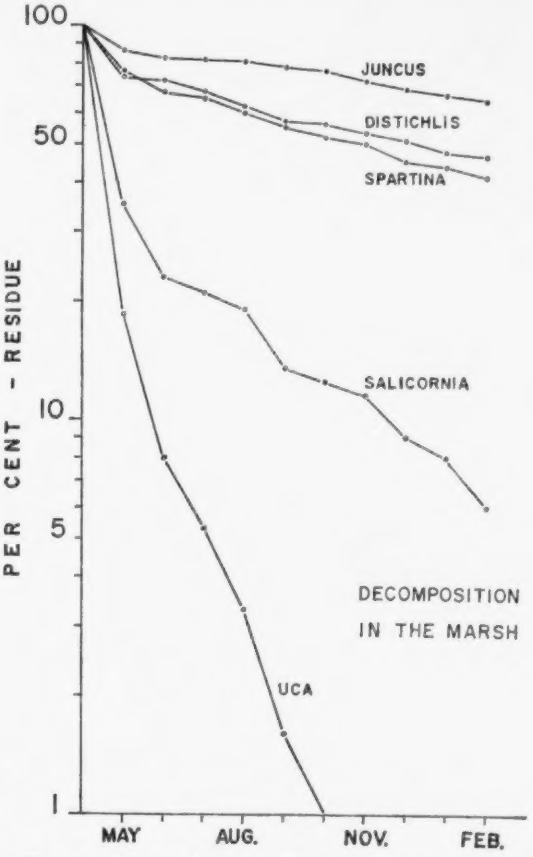


Fig. 5. Decomposition rate expressed as percentage of residue of initial dry weight of samples of dead individuals of four species of salt marsh plants (*Distichlis, Juncus, Salicornia,* and *Spartina*) and crabs (*Uca*).

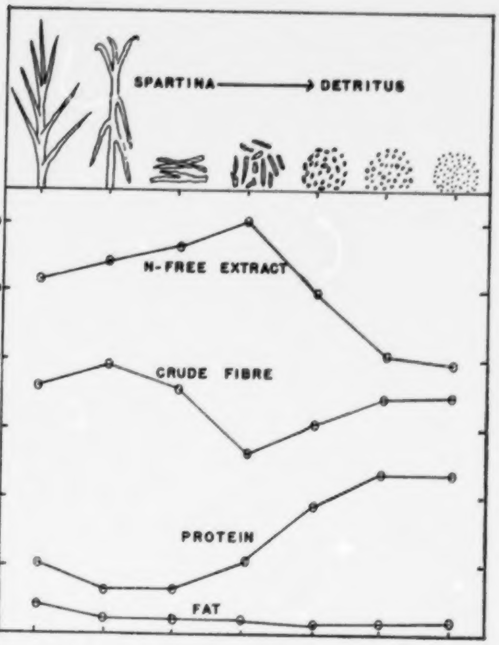
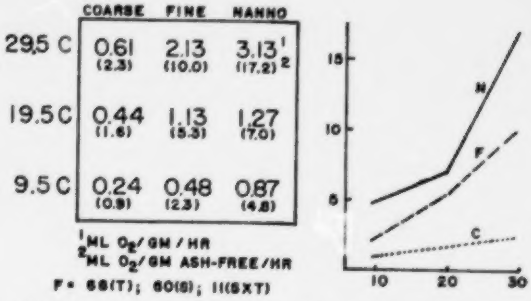


Fig. 6. The nutritive composition of successive stages of decomposition of *Spartina* marsh grass, showing increase in protein and decrease in carbohydrate with increasing age and decreasing size of detritus particles.



	COARSE	FINE	NANNO
29.5 C	0.61 (2.3)	2.13 (10.0)	3.13[1] (17.2)[2]
19.5 C	0.44 (1.6)	1.13 (5.3)	1.27 (7.0)
9.5 C	0.24 (0.9)	0.48 (2.3)	0.87 (4.8)

[1] ML O_2/GM/HR

[2] ML O_2/GM ASH-FREE/HR

F = 68(T); 60(S); 11(SXT)

Fig. 7. Oxygen consumption of the three size fractions of detritus under constant temperature conditions in darkness in the laboratory. Means for each size-temperature category (10 replications) are shown in the table and temperature-respiration rate (in terms O_2/gm ash-free) curves are shown in the graph. F values for analysis of variance are shown below the table. Both temperature and size affect O_2 consumption to a highly significant degree at the 99 percent level.

great in "nanno detritus" (that which passes through a No. 25 net—200 meshes per inch; 0.064 mm per aperture) as compared with coarse detritus (that retained by a No. 6 net—74 meshes per inch; 0.239 mm per aperture) indicating increasing microbial activity with age. The nanno fraction comprises 95 percent of the total particulate organic matter. Thus, the bacteria-rich detritus is nutritionally a better food source for animals than is the *Spartina* tissue that forms the original base for most of the particulate matter.

Authors' Note: This paper is Contribution No. 118 from the University of Georgia Marine Institute.

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MAN AND THE LANDSCAPE

WASTE MANAGEMENT AND CONTROL. A Report to the Federal Council for Sciences and Technology by the Committee on Pollution. Athelstan Spilhaus, Chairman. Publication 1400, National Academy of Sciences, National Research Council. 257 pages, Washington, D.C. 1966.

By EUGENE P. ODUM

IN CARRYING OUT ITS MISSION as an advisory body on matters of national interest, the National Academy of Science often relies on what might be called "the interdisciplinary report-writing committee." The idea, of course, is to assemble a group of volunteers who are both knowledgeable in the problem area and willing to fly to Washington on weekends, and charge them with producing a report. An all important ingredient in this prescription is an articulate chairman known to be able to extort work and synthesis from individualistic experts who are already professionally overworked. It is a minor miracle of human endeavor that reports, sometimes even good ones, are actually prepared in this manner!

In my opinion "Waste Management and Control" is one of the good ones because it achieves a real synthesis of the overall problem of pollution, while at the same time presenting data that show where we stand today in regard to the different segments of the problem. Despite its prosaic title the bulletin is also quite readable. It would serve as an admirable text for a course in pollution for citizens. Supplemented by journal literature, it could also serve as a text in a college course in "pollution ecology." Published under a more interesting title with more illustrations and less cautious conclusions, the report would deserve to become a best seller. It is a tribute to chairman Spilhaus, his central committee of Garrett, Kneese, McMahon, Pike, Shea, Stevens, Wolman, and the more than one hundred other professionals who contributed, that the report is both scholarly in content and timely in its appeal to a wide audience.

The book is divided into two parts—a series of very short summary chapters occupying the first twenty-six pages and eight appendixes which go into the more technical details. In addition to Spilhaus' foreword, the summary statements are headed (and subheaded) as follows: introduction; the nature of the problem (air, water, and land pollution); legal, legislative and institutional problems; areas of inadequacy (unknown technology, constraints on existing technology, research and education); possible improved approaches (available basic methods, auxiliary techniques, public policy and institutional arrangement); recommendations. The appendix chapters are entitled: (1) pollution processes in ecosystems, (2) criteria, instrumentation, and monitoring, (3) the transport system, (4) the residue situation—current and future, (5) pollution-abatement technology, (6) legal and public administration aspects, (7) public policy and institutional arrangements, and (8) a brief analysis of pollution in the Delaware estuary. For the non-professional citizen the short summary chapters at the beginning and the final chapter with its fifteen charts on the Delaware valley (as a model for the kind of local analysis required) provide the most rewarding reading.

Even if one should read only the foreword and the introduction the message of the report is clear: *Technology alone cannot solve the pollution dilemma; scientific and public awareness that man and the landscape function as a whole is also needed.*

Unless society accepts the fact that man is a part of nature as well as a manipulator of nature and is willing to place certain constraints on himself, then we shall in all probability continue to lose ground in our efforts to maintain high quality environment. In other words, improvements in the technology of waste management will continue to lag behind the technological production of wastes and the sheer mass effect of growing human population. Such a trend is all too evident today. There should be no lessening of efforts to improve the technique of waste control, of course, but there must also be great improvement in scientific integrity at the environmental and social levels if knowledge is to be applied in the public interest. One might even suggest that the title of the report should have been: "Waste Management and People Control," meaning, of course, "by" and "for," as well as "of" people!

It should be pointed out that my words in the preceding paragraph are somewhat stronger than the statements in the Spilhaus report. Since the National Academy is an advisory, not an action body, its reports are written to be informative only. Nevertheless, this general theme comes out in many places, as is evident by the following sample quotations:

> The fact is that pollution is everybody's business, and yet there are wide differences in desires and ambitions for multiple uses of our environment. Because of this, it is necessary to embark on a program of public awareness that extends down to the grassroot level (page 7).

> Up to the present time it has been possible to sidestep many problems: partial remedies giving temporary relief have seemed to some to be permanent solutions. But now, a little past mid-twentieth century, the situation is unprecedented and becoming desperate (page 10).

> Few have looked at man and his environment as a whole (page 31). We must adopt a very broad concept of pollution. If we can relate these residues to the normal functioning of the ecosystem, we are most likely to be successful in our attempt to cope with the problems (page 35).

> One bitter lesson has been learned from past "laissez-faire" approach to residue disposal. Scarce water and land resources have been spoiled, some of them beyond recovery (page 32).

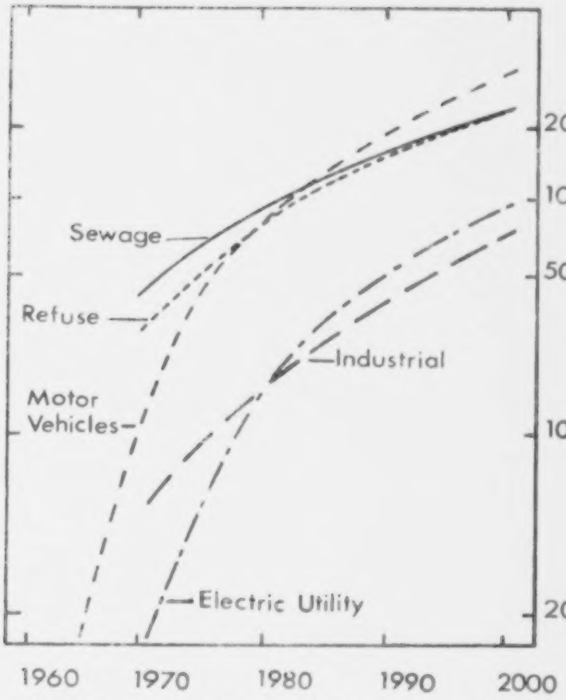
It is not difficult to read between these lines to sense the feeling of urgency with which the committee and its consultants have approached the writing of NAS Bulletin 1400. The essence of the two pages of recommendations which close the summary section of the report is that the situation is so critical that the federal government should now take the initiative in establishing standards in conducting feasibility studies on new approaches, and in promoting public awareness. It would be better, of course, if some of the initiative could come from the local level, but the committee apparently feels that there may not be time for "grass roots" impetus.

Scattered throughout the report are a number of clever phrases some of which could serve as slogans in achieving the urgently needed public and political awareness that pollution is a matter of citizen concern, not just the business of a few highly trained federal technicians. Here are some examples: "Pollution is a resource out of place." "One person's trash basket is another's living space." "The degree of cleanliness in the environment is a matter of the informed choice of the people." "Cleaning up costs money." "If we close the loop from user back to resource so as to remake the discard we approach the ultimate solution."

One difficulty is that the kind of environmental science needed to accompany waste management technology is so poorly conceived and lacking in development in our educational institutions that it does not even have a generally accepted name! "Landscape ecology" or "human ecology" might be suggested, but many would find these designations inadequate or confusing because of superficial treatments that have appeared under these headings in the past. Briefly mentioned in the report is the possibility of resorting to a "systems approach" which quantitates properties and exchanges between resource units that are linked together in a reciprocal manner. Such approaches will undoubtedly be increasingly useful since they are particularly applicable to computer programming, but they are still only techniques. We have so little basic understanding of environmental interaction that we do not yet know how to set up units or compartments so as to take advantage of computer technology. This is nowhere better illustrated than by the fact that we are now utterly unable to set up a truly regenerative life support system for space travel. No one knows what the minimum space is that would be required to support one man for long periods, if he is to obtain all his food and regenerate all his wastes within that space. Ironically, we may have to face this problem here on earth before we get to the point of long space trips.

I believe that what we now need is hinted at in Appendix 1, which is an excellent discussion of the ecosystem concept as applied to pollution processes. The word "ecosystem" (shortened from "ecological system") is a convenient, semi-technical way of expressing what we mean when we speak of the oneness of "man and nature" or "man and the landscape." A science of ecosystems, or ecosystem ecology, would seem to be as good a handle as any for that branch of environmental science which must be accelerated. It is a tribute to the leadership in the St. Louis region that Washington University has been one of the first to set up a graduate training and research program along such lines.

Legal and administrative problems loom as another major barrier to resolving the pollution dilemma. Laws, codes and regulations regarding pollution control are inadequate and often conflicting in most states. Thus



THE GRAPH IS A PROJECTION of the cost to the consumer, in millions of dollars, of the control of primary pollutants in the Delaware River Basin. (Adapted from "Waste Management and Control")

we not only need a new environmental science of ecosystems, but we also need breakthroughs in "landscape law" that will permit the drawing up of a "bill of rights" for the environment as well as realistic enabling bills for legislative action.

Going a step beyond the report, I believe we should begin thinking about *landscape zoning* as a means of solving multiple use conflicts. Everyone agrees on the principle of zoning in cities since a given piece of land cannot serve both as a factory and a residential site. Why not then zone paper mills so as to place them on the part of the landscape where water and air flows provide the best waste disposal possibilities? I realize that such procedures are fraught with difficulties, especially at the political level, but at least we ought to talk about it. The nearest thing we have to landscape zoning now is the so-called "multipurpose use" concept. As pointed out in the report, this approach is not working very well because the "purpose" with the greatest economic output completely overrides any other purposes with which it may conflict. It is ecological nonsense to think that we can have the maximum efficient use of everything on the same area. We can, however, compromise with lower demands for several uses, or we can zone areas for particular purposes while keeping the interdependence of zones constantly in view to maintain the total landscape in good condition. Both procedures are desirable, but the latter is especially attractive because men do have single track minds and demand specific returns from their landscapes.

When the committee on pollution first undertook to make the study in 1964, it anticipated using the Delaware River Basin as a model to show how interacting elements could be identified in a specific region where it was thought that the pertinent data could be found in sufficiently organized form for study. In the revealing words of chairman Spilhaus:

> Unfortunately, this hope was not realized. The Delaware River estuary region comprises about 1,600 square miles in which function the governments of three states, 11 counties, and 377 municipalities—each with some degree of autonomy. Also in this area are some 4,000 civic organizations having diverse, and often conflicting, interests. The political and institutional barriers to the compilation of sensible regional data and to the coordinated management of remedial programs are formidable. Although existing data for pollution are impressive in quantity, they frequently were found to be unprocessed, or not to bear on the problem in a useful way.

Thus, the committee was not able to assemble a precise pollution case history as originally intended, but it remained convinced that the regional approach "is needed and could be rewarding." It is no wonder that the committee has concluded that the Federal Government must somehow step in!

Despite the failure of the regional model, the charts on the Delaware Valley in the appendix are well worth study. The projected costs of future pollution control are frightening to any taxpayer. Below, I present a figure from this section of the report, relabeled in nontechnical language to illustrate what the citizens of Delaware Valley will have to pay during the next thirty-five years. Here we see that some four hundred millions of dollars have already been spent on municipal sewage and refuse to achieve some degree of present day control; less than a tenfold increase is projected for cumulative costs to the year 2000. On the other hand, very little money has yet been spent on motor vehicle, industrial and electric utility pollution. Most people are hardly aware that these sources will be major problems. Yet estimated cumulative costs to control each of these sources is projected to be at least as great (about one billion dollars) as that which will have to be spent to control domestic sewage. Even these large sums are no guarantee against irreversible changes in the natural decontamination capacity of the environment on which we now so largely depend. When that capacity is lost no amount of money will do any good.

It is often said that social reforms do not come about until they become economic necessities. One look at projections such as this should convince all of us that pollution [illegible]

OYSTER CULTURE WORKSHOP

SAPELO ISLAND, GEORGIA

July 11, 1967

Opening Remarks: Natural Production in Estuaries, A Source of Food for Oysters.

By: Eugene P. Odum, Institute of Ecology, University of Georgia, Athens.

About 15 years ago when research was started at Sapelo we knew that the day would come when greater human use would be demanded of the Georgia estuaries. We knew that conflicts between uses, such as, waste disposal, dredging for navigation, recreation and seafood production would intensify. We felt that the Georgia estuaries were somehow fertile and that seafood should receive major priority. Yet, this potential would have been difficult to sell 15 years ago because there were no data on primary production, and comparatively little seafood was actually being harvested at the time.

The conventional approach would have been to launch direct studies on species of fish, shrimp and shellfish of current economic importance. However, we felt that first a study of the basic mechanism leading to seafood production was needed. In other words we chose to start at the beginning of the food chain and work towards the harvestable consumers, rather than the other way around. We reasoned that a basic understanding of the pattern of energy flow and nutrient cycling that underlie the production mechanism should contribute not only to the conservation of existing commercial species, but also to the discovery of untapped sources of energy that might in the future be converted into useful products.

Through the generosity and vision of Mr. R. J. Reynolds, Jr., and the Foundation he created, basic studies of this type have been and are now being carried out at Sapelo by staff, students and visiting investigators who are motivated by the challenge of the uncharted, and who are attracted by the atmosphere of freedom to do research according to their own dictates. I recall discussions with the first staff in which we all expressed the hope that we would have at least 10 years time for quiet study before we would need to think about applications. However, the pressures of man's practical world are mounting rapidly, and, ready or not, we now must move up the food chain in our thinking, so to speak. This workshop on oyster culture thus comes at a very opportune time. I believe we have discovered where the productivity is in a coastal plain type of estuary; the challenge now is to determine how best to use it.

Estuaries tend to be naturally fertile because physical conditions are favorable for the rapid regeneration of nutrients and the growth of both microscopic and macroscopic plants. In Georgia estuaries marsh grass and benthic algae contribute importantly to the fertility of the waters, along with phytoplankton. Energy flow follows a complex food-web pattern in which microbialenriched detritus from decaying marsh grass plays a major part. From the viewpoint of potential consumers, fertility is a matter of suspended and sedimented particles ranging in size from bacteria and nannoplankton to fecal pellets and macroparticles composed of clay and organic matter coated with microorganisms. When I speak of "particles" in this paper, I am referring to both plankton and detritus. The water is muddy but this so-called "mud" is full of food energy for those organisms which can use it. To harvest this fertility one naturally thinks of suspension and deposit feeders. Rehabilitation of the oyster certainly deserves first consideration because we know that it was once abundant in these waters. Raft and long-line culture hold great promise as a repopulation and continuous harvest procedure. What we now need to know in detail is what portion of the suspended particle spectrum oysters use. In other words, I am suggesting that we rephrase the often asked but not too well answered question, "what do oysters eat" by asking, "what can oysters eat". We have found that the detritus particles, especially the "nanno-detritus" (particles small enough to pass through a fine plankton net) contain a high per cent of protein on an ash-free basis. The ash, however, presents problems for a suspension feeder's filtering apparatus. It is perhaps feasible to develop, by selection, a strain or species of oysters that can use a large portion of detritus in its diet. Such an oyster would be better adapted to the coastal plain salt marsh type of estuary than oysters adapted to phytoplankton-dominated waters. Surveys of particle-size distribution in different parts of the estuarine system should prove important in the location of cultured oysters where size and type of suspended particles are most favorable for particular sizes and types of oysters. This is just one aspect where basic research can contribute to the development of a regionally-adapted oyster culture.

We have estimated that the combined primary production of marsh grass, benthic algae and phytoplankton in Georgia estuaries is up to 10 tons of organic matter per acre per year. Based on a 10% ecological conversion factor, we might be able to produce up to 2000 pounds of harvestable consumers per year on an intensively managed acre, and perhaps up to 200 pounds per acre over a wide area. Yields such as these, of course, are realized in the far east. To do this we will have to learn how to channel energy from all three primary sources into the secondary crops. At least these are goals to work towards.

In closing, I would like to reemphasize that the general approach to aquaculture must be different from that of conventional agriculture. In most agricultural procedures, the natural ecosystem is completely replaced by a cultured ecosystem,-the land being adapted to the crop, so to speak. In estuarine aquaculture the problem is to adapt the crop to the natural ecosystem so as to harvest but not disrupt the already existing fertility, with the cost of environmental manipulation being kept as low as possible. I think that we should avoid at all costs the one-crop or monoculture philosophy of agriculture. In our enthusiasm for oyster culture we should not forget that diversified cropping is highly desirable in an estuary. When man puts too much pressure on any one organism, a boom and bust cycle is almost inevitable. Furthermore, since the sources of primary production are varied, a diversity of harvestable consumers will be required for maximum yield and stability. For example, since the food particles come in many types and sizes there should be a spectrum of consumers able to utilize as much of the range of particle sizes as possible. This means consideration not only of filter-feeders, but deposit feeders such as fishes and crustaceans, especially those able to utilize the larger items.

Monoculture just will not work in a estuary unless one is prepared to convert the whole system into a culture pond and thereby destroy the many other values and uses of estuaries. The challenge, then, to this workshop is two fold: (1) How can we restore the oyster to its rightful place as a major seafood product of estuaries, and (2) How far should we go in promoting its culture.

The Urgent Need for Landscape Zoning of the Estuarine Region According to Ecosystem Principles*

Eugene P. Odum
Institute of Ecology
University of Georgia

My theme is an impassioned plea for a package of three basic approaches in regard to estuaries: (1) Consideration of the estuarine landscape as *one major ecological system* (ecosystem) with interdependent components and functions; (2) recognition by professionals and the public alike of the basic *ecological laws* that result in conflict between "man" and "nature" as the first step in resolving multi-purpose conflicts; and (3) need to establish immediately a ground swell of public opinion for *landscape zoning* as the only practical solution to desired multiple use objectives which must involve both preservation and use.

Too often conservation conferences end up in a two step frustration pattern something as follows: First, individual speakers present logical and impassioned pleas for this or that species or problem, after which it is suggested that "we all must work together" even when it is quite obvious that species-oriented or problem-oriented missions are often in basic conflict with one another. It is no wonder that the public becomes confused when professionals do not recognize their own conflicting missions, as, for example, some of the following: "clean" (i.e., nutrient poor) water for recreation vs "dirty" (i.e., nutrient rich) water for fish production; waterfowl requiring macrophytes vs shellfish requiring microphytes; nutrient stripping to reduce algal production vs fertilization to increase primary production; single species (monoculture) management vs total yield (multispecies culture) management. It should be obvious that our thinking should come up to the level of the ecosystem, that is, we now need to consider the landscape as a whole if we are not to make a mockery of the concept of "multipurpose use". It is ecological nonesense to think that we can have the highest yields or maximum efficient use of everything on the same area. We can, however, compromise with lower demands for several uses that maintain maximum total production, or we can zone areas for particular purposes while keeping the interdependence of zones constantly in mind. Both procedures are probably desirable, but the latter is especially attractive because men do have single track minds and demand specific returns from their landscapes. Furthermore, the nature of estuaries is such that we must "have our cake and eat it too" meaning, that in any program of harvest, biological structures,-such as oyster banks,- must be maintained against the erosion of physical forces. Therefore, management of estuaries must be based on rather different principles than those employed in conventional monoculture agriculture.

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* Address presented at a Symposium of Estuarine Ecology of Coastal Waters of North Carolina sponsored by Water Resources Institute of the University of North Carolina held at Raleigh, N. C., May 12, 1966. Contribution from the Marine Institute, University of Georgia.

The actual and potential productivity of landscapes is a matter of increased study and concern as man faces up to a crowded biosphere. An "International Biological Program", or IBP, is now being organized on this theme, with working groups in practically all countries. Equally important to a knowledge of primary production is an understanding of the energy flow patterns involved in the utilization of the primary food source. Again, the utilization phase of productivity is a key motivation in IBP. We have proposed two contrasting working models for the utilization phase; namely, the grazing food chain system and the detritus food chain system (See Odum, 1963, "Ecology", Holt, Rinehart and Winston, N. Y. pp. 42-46). The former involves rapid, direct utilization of growing plants with little storage or accumulation of organic material or species diversity on the landscape; such a system is characteristic of the unstable early developmental stages of nature, and is the basis for man's present intensive agriculture,-i.e. the grass-cow-man or wheat-man food chains,- which are stabilized by an imput of mechanical energy. In contrast, the detritus system involves delayed utilization of primary production which results in maximizing standing crop, species diversity and biological stability; such systems are characteristic of mature or climax ecosystems, and have been relatively little used as food sources by man.

Estuaries are among the most naturally fertile of landscapes having high rates of gross primary production which are stabilized by the mechanical imput of tidal energy (See Odum, N. Y. Conservationist, June-July, 1961, pp. 12-15 or Odum and Schelske, Bull. Gulf and Caribbean Fisheries Institute, Nov. 1961, pp. 75-80). They many be classed as "fluctuating water level ecosystems." It is important to note that one of the most successful types of agriculture developed by man is rice culture which is this type of ecosystem in that long-term stability and fertility are maintained by alternate flooding and draining of the landscape. In estuaries, tidal energy does this work "for free". Estuaries are also generally to be classed as detritus systems as shown by the energy flow patterns that have now been charted (See Teal, Ecology, 43:614-624, 1962). That is to say, only a small fraction of primary production is grazed directly; most find its way into food chains as organic detritus. Our recent work at Sapelo with introduced radionuclide tracers shows clearly that the primary uptake is by way of detritus-rich sediments rather than by way of primary producers as such. Instead of grazing "cows" the estuary is populated with filter and deposit feeders which have a potential protein yield that is often greater than that achieved in terrestrial animal husbandry. The problem is, of course, that it is more difficult, or at least requires a different approach, for man to obtain an immediate yield from a diversity of consumers.

So far man has depended almost entirely on the grazing or granivorous food chains for his food; most of his highly developed agricultural systems are of these types. Since detritus systems seem to have a greater buffering effect on fluctuations in the physical environment, and, thus, greater inherent stability it might be well for man to consider the possibility of greater use of systems of the detritus type. Detritus might be utilized directly by man in two ways: (1) cellulose and other undigestable materials might be converted into metabolizable energy by suitable enzymes or by bacterial action as is now done in silage preparation, (2) or detritus-feeding animals can be harvested or cultured such as is already done in some types of tropical fish and shellfish culture. In fact, most of our present harvest from our estuaries comes by way of the detritus food chain. Larger yields can perhaps be obtained by converting large particulate material for direct use and allowing the bacterial-rich small particles to feed animals. The detritus system would seem to be especially desirable in warm climates, not only in estuariesbut also on land, where a large biological structure is necessary for mineral retention and recycling and where insect damage to crops that have a high nutritive value is inherently great. The beauty of an estuary is that the rhythmic water movement and mixing create a self-fertilizing and self-adjusting system. Furthermore, estuaries have many values to society other than potential food sources, as for example, protection against storms, recreation, and waste purification. Much is being said these days about restoring the "quality of man's environment;" certainly, the broad sweep of unpolluted wetland does much to insure a high quality and diversity of our long coastline.

Rather than attempting to convert estuaries, at great expense, into conventional agricultural lands (or worse still, into sewers or building sites), it is our contention that the natural fertility of estuaries can be best utilized by man by tapping the detritus food chain in the several ways as indicated. We can thus "have our cake and eat it too" in the sense that protection, stability, diversity, recreation and other important functions of landscapes can be assured while at the same time substantial yields of food or other products can be obtained. If we apply our present knowledge of primary production and two basic ecological rules we can come up with an estimate of food potential. The net primary production of southeastern estuaries is of the order of 10 tons organic matter, or 40 million calories, per acre-year. At 10% efficiency at each step in the food chain, four million calories might be converted to animal protein. If we harvest one half of this, so as to insure maintenance of the standing crop, we might get two million calories/acre. Even one million is of far greater value to the protein-starved world of the future than the present economic value of sport fishing or hunting. In my opinion we ought to base the "real estate" value of estuaries on this potential productivity, not on present market values which are low because people do not recognize the potential of so-called "waste lands". To achieve such utilization we need a crash program of study on "detritus agriculture", and such studies can only be accomplished by an interdisciplinary team approach because no single academic or applied discipline at the present time is oriented to this concept.

In a recent conference on Estuaries held at Jekyll Island, Georgia (proceedings to be published as a special volume by the American Association for Advancement of Science), several exciting new studies were presented that point to unique productivity mechanisms of estuarine ecosystems. For example, many animals apparently can absorb organic nutrients directly (and thus short-cut food chains) in waters of moderate salinity, but are unable to do so in freshwater. Small non-economic animals are very important in creating a "nutrient trap" or refertilization mechanism. Detritus from marsh grass increases in protein and vitamin content (and hence in food value to filter and deposit-feeding economic animals) as acted on by microorganisms in the warm, circulating waters. I believe we are just beginning to understand why estuaries are the preferred nursery grounds for so many important coastal fishes!

While we push ahead with research it is equally urgent that the idea of landscape zoning become generally accepted. Everyone agrees on the principle of zoning in cities since, for example, a given piece of land can not serve both as factory and residential sites. Why not then zone for and against paper mills according to the ecological nature and potential value of the site? Before effective zoning plans can be implemented the legal tangle regarding ownership of and responsibilities for, the estuarine landscape must be resolved. We need a class of dedicated "landscape lawyers" to help untangle the mess and present reasonable enabling bills for legislative action.

North Carolina has a unique opportunity to establish leadership in setting up a zoning plan, say for the Pamlico Sound region, in conjunction with the expanded research effort and increasing use demands now evident. Some of our states to the north are faced with a "too late-too little left" situation. There is yet time in the southeast, but not much.

Petroleum Council of Georgia

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C. L. BEARDEN
CHAIRMAN

ERIC HOLMES, JR.
EXECUTIVE SECRETARY

February 21, 1968

Mr. John R. Thoman, Regional Director
Southeast Region
Federal Water Pollution Control Administration
U. S. Department of the Interior
1421 Peachtree Street, N. E.
Atlanta, Georgia 30309

Dear Mr. Thoman:

Thank you for your kind invitation to appear at the public meeting at Jekyll Island on February 29. Unfortunately, the press of other business prevents me from appearing in person, but I should like to request that the following brief statement be read into the record:

On behalf of the Petroleum Council of Georgia, I should like to say that our industry believes the present national study of estuarine pollution is of great potential import. Reasonable standards of estuarine quality should be set and enforced to secure the continued beneficial use of this valuable natural resource.

Although there is little that our organization itself can contribute to the present study, we have learned that the American Petroleum Institute's Committee for Air and Water Conservation is now conducting a comprehensive survey of the technical literature for the purpose of developing criteria for estuarine water quality. The assistance of Professor A. K. Sparks of Washington State University and Professor C. B. Wurtz of La Salle College has been solicited in the development of these criteria.

We are told that the Institute plans to publish the criteria sometime within the next sixty days and that the document will contain suggested limits for the various critical parameters of estuarine water quality in different geographic areas. Upon publication, the criteria will be distributed to interested parties, including the federal Water Pollution Control Administration.

Respectfully submitted,

Eric Holmes, Jr.

Eric Holmes, Jr.
Executive Secretary

Gasoline's a Buy . . . Only the Tax is High

ATLANTIC STATES MARINE FISHERIES COMMISSION
3965 WEST PENSACOLA STREET
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DEVELOPING AND MANAGING

ESTUARIES

DEVELOPING AND MANAGING ESTUARIES

A Statement of Policy and Guidelines for Effective Actions

The most useful aquatic areas in the world are in serious danger of destruction. The estuaries, where fresh water, land and sea meet in a dynamic and productive zone, are gravely threatened through unwise and unplanned excessive use of their valuable capacities. Specific problems in estuaries vary almost infinitely, but guideline policies are pertinent to most of the management problems involved. This statement presents such suggestions related to policies.

Estuaries include the coastal zone which is affected by both the run-off of fresh water from land and the salt water from the sea. This zone includes tidal rivers, marshes, bays and river mouths, the inshore edge of the ocean, and the land areas which interact with these. Policies for use of these areas should be based upon the natural resources contained in this great coastal zone and upon the complex human uses made of the zone.

The value of estuaries is well established - but appreciated by only a tiny group. It is not appropriate to provide here detailed statistical summaries, but the intense uses being made of coastal waters must be noted because they are so expansive, so competitive and potentially so destructive. All shipping for industrial or military purposes begins and ends in estuaries. The wastes of the great coastal industries and of a third of the people in this country are poured into these waters. About three-fourths of the fish and shellfish needed for food production and recreational fishing are totally dependent upon finding suitable conditions in estuaries. The coasts are in exploding demand for aesthetic and recreational use.

Each of these is an important human use - but shipping requires dredging and spoil disposal and too often produces destructive oil slicks or spilled toxic cargo. Treated sewage ruins healthy water by over-enrichment, and poisonous industrial wastes are still increasing. Even aesthetic use, which almost sounds above reproach, irretrievably destroys the ecosystem when vast areas are dredged or filled for housing - so that part of the reason for moving to the shore no longer exists. All of these uses, and others, have developed without comprehension of their effects and interactions and without plans for an optimal balance for present or future human uses. Present and potential uses involve vast and complicated economic problems, political and geographic difficulties, grave social questions and frightening legal complications. Nevertheless, they must be resolved, since the uses and abuses of estuaries are now unmanaged, irrational, and often absolutely incompatible.

The estuaries are complex. A marvelous and productive ecosystem has emerged slowly over thousands of years. The river, the land and the sea all make essential contributions. Biologically, the estuarine zone contains a unique mixture of species which produce very large crops. Some species are permanent residents, taking full advantage of the capacity of the estuary to trap nutrients. Others use the estuary as the oceans' greatest nursery or as a grazing area. The estuarine ecosystem is not yet fully comprehended, but enough is known to show that the entire system can be easily damaged or permanently destroyed if detrimental changes occur in the river, on nearby land or marsh, in the coastal ocean or in the estuary itself. It is extremely easy to destroy quickly resources which cannot be renewed as rapidly - or to destroy permanently and irreversibly an essential link in the estuarine ecosystem.

As guidelines to effective management of these areas, the following specific proposals are made:

1. The objectives of estuarine management must be identified and agreed upon.

2. An adequate inventory must be made of the estuaries and of their present and potential human uses.

3. Research must be intensified to provide the bases for rational decisions.

4. Controls must be established over the alterations which are occurring and those which will be proposed.

5. Immediate action should be carried out at all levels of government toward improved management.

All of these are urgent requirements and very difficult tasks. Many points of view must be expressed and reconciled, and the Atlantic States Marine Fisheries Commission suggests that the following comments may provide some initial stimuli:

In selecting objectives:

a. Multiple usage exists and will be intensified. A rational balance among such uses will be required.

b. Long-term objectives must take clear precedence over short-term gains. This is especially critical when a short-period use would destroy an essential link in the ecosystem.

c. The objectives must be consistent with the basic principles of biology, chemistry, physics, economics and government or they are doomed to failure.

d. Objectives will inevitably vary from place to place and from time to time. General objectives must, however, be sought for large coastal areas and specific objectives must be clarified for each watershed system.

On taking inventory:

a. In general terms, our estuaries have never been properly described. Good management will require thorough description of these areas and resources, careful analyses of all of their present uses and projection of the best possible estimates of future uses.

b. Inventory must also include measurements of present and potential damage and losses, based upon reasonable measurement and prediction.

c. Valuable leadership has been given by such states as Massachusetts, New York, Delaware and others, by the federal-state efforts toward an estuarine inventory along the Gulf of Mexico, by the wetlands surveys of the Bureau of Sport Fisheries and Wildlife, by the new program of the Marine Resources Committee of the Belle W. Baruch Foundation and by other agencies and individuals. These now provide useful assistance, but will not alone be adequate.

d. Inventories must be carried through to estimates in terms of measurable economic value.

e. Adequate and standardized methods for inventory are generally lacking. They are urgently needed and should be developed at the earliest possible moment.

f. Statistical systems for recording and analyzing the many uses of estuaries are insufficient. They must be improved and more widely utilized.

On research:

a. Although present levels of research in estuaries are impressive, the emphasis is very recent. Knowledge is far from sufficient to provide the specific details and broad principles which must be available for optimal management.

b. Research should be carried out at all pertinent levels of basic science and of applied science. The upper limit should be set only by the availability of competent scientists. Research should be supported at colleges and universities, in private industry, at state and federal laboratories, and wherever else competence may appear.

c. Biological research is especially needed on the life history and requirements of useful species, on the causes of natural and man-induced fluctuations in abundance, on the biological effects of various modifications in the coastal environment, and on the flow of energy into and through the various estuarine ecosystems.

On control:

a. Jurisdictional responsibilities must be clarified. These will be very difficult indeed, since they involve private owners, towns, counties, states, the national government and occasionally international groups. These often involve traditional and jealously guarded patterns. It is also true that ownership often differs from jurisdiction for management (by health controls, fishing regulation, pollution laws, etc.). Without clarification of jurisdiction, however, optimal management can never be achieved.

b. Traditional responsibilities of the states and of the federal government are central to effective controls and merit urgent attention and clarification.

c. Controls cannot be adequately designed or effectuated without prior selection of objectives, inventory and research.

d. In view of the present rapid degradation of our coastal areas, interim controls are imperative. These must be conservative. We suggest that controls must be most conservative where knowledge of effects of change is weakest.

e. Zoning of specific locations and areas of estuaries appears to be an essential tool for management. There is substantial danger, however, that zoning may be carried out with insufficient regard for the essential unity of the estuarine system and without proper attention to the distant effects of local uses.

On action:

a. At the LOCAL level, we urge

(1) public education on estuaries.

(2) analysis of legal problems in management.

(3) specific conservative controls when pertinent.

(4) acquisition of title or the development rights of border lands and waterways in the public interest.

(5) zoning of coastal areas, based on a conservative approach and implemented by strong regulation.

b. at the STATE level, we urge

(1) public education on estuaries.

(2) formal and definitive analysis of legal problems, with development of specific corrective legislation.

(3) firm and conservative interim control of the uses of the estuary, especially for

(a) domestic and industrial waste disposal.
(b) dredging and spoil disposal.
(c) destruction of wetlands.

(4) thorough inventory of present and future values and losses, in close cooperation with other agencies.

(5) thorough monitoring of present water and land quality and of changes occurring in that quality.

(6) rapid acquisition of appropriate estuarine areas.

(7) fresh and comprehensive development of objectives, policies, plans and practices

for the optimal management of estuarine areas.

(8) support and encouragement of research on the estuary, to permit protection of present values, prevention of destruction, and positive achievement of the optimal values of these areas.

(9) effective coordination of the many government agencies involved in estuarine use and management.

c. At the INTERSTATE level, we urge

(1) support of public education on estuaries. For the Atlantic State Marine Fisheries Commission, this will include preparation of a leaflet of excellent quality on the nature, values and optimal uses of estuaries. This could be widely distributed to public officials for present guidance and to schools for education toward the future.

(2) vigorous support of state and federal efforts toward development of objectives, inventory, research and control.

(3) further expression of a strong and persuasive statement of policy on estuaries.

(4) development of suggested legislation on estuarine development and management.

(5) improvement of mechanisms for dealing with situations, where two or more states are involved in estuarine problems.

(6) interstate planning for protection and enhancement, as is being accomplished by several river basin commissions.

d. At the FEDERAL level, we urge

(1) public education on estuaries.

(2) efficient coordination among the several departments and multiple agencies which are involved in estuarine responsibilities.

(3) appropriate research by federal agencies and support of research by other competent agencies and individuals.

(4) special leadership in development of methods for inventorying estuaries, evaluating the uses of estuaries and expression of federal policies.

(5) continued acquisition of appropriate areas, through federal or cooperative federal-state programs.

Adopted by the Atlantic States Marine Fisheries Commission, October 7, 1966 at Portland, Maine

Ronald W. Green, Chairman

Recommended by the Biological Committee of the Commission

Dana Wallace &
David H. Wallace, Co-Chairmen

Prepared by the Estuarine Committee

L. Eugene Cronin, Chairman
Robert Dow
Robert Hutton
G. Robert Lunz
Eugene P. Odum
John Poole
Roland Smith
Albert Swartz
Frederick Wilbour

THE CONSERVATION AND UTILIZATION OF ESTUARINE RESOURCES

Statement by
The Georgia Institute of Technology*

The Georgia Institute of Technology is pleased to participate in this Public Meeting. We congratulate the Federal Water Pollution Control Administration for using this method of obtaining information and opinions from individuals and groups concerned with the estuarine resources of Georgia and the Nation. The need for remedial and preventive planning and management of these resources was recognized in the legislation which authorized the National Estuarine Study. Thus, the Study is a significant symbol of our collective resolve to protect and utilize our estuaries optimally for the region and the Nation.

Under the provisions of Public Law 89-753, the Federal Water Pollution Control Administration will prepare a report for the Secretary of the Interior, and the Secretary will present the report to Congress with recommendations for a comprehensive National program for the study, preservation, development, and use of estuarine and related resources. The outline for the Secretary's report is shown in the booklet entitled "National Estuarine Pollution Study", July 1967, which was distributed with announcements of the meeting. We are especially pleased that the outline recognizes the extensive external effects of and on estuarine zones. We are pleased also that it emphasizes the need for a partnership effort, involving private interests as well as Federal, State, and local governments and institutions. The fact that widespread public concern with estuarine resources has been so long delayed makes it most important that we pool our information, talents and facilities, and that we resolve such conflicts of interest and opinion as may exist with respect to their conservation and utilization.

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*Presented by C. E. Kindsvater, Director and Regents' Professor, Water Resources Center, Georgia Institute of Technology, Atlanta, Georgia 30332, at a public meeting sponsored by the Federal Water Pollution Control Administration at Jekyll Island, Georgia, February 29, 1968.

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Needless to say, recommendations for a National estuarine resources management program must be based on a good understanding of the nature and magnitude of the problems involved. Unfortunately, we are concerned with one of the most complex and most dynamic systems in nature. When it is further complicated by the activities of man and man's ever changing, ever increasing needs, it becomes one of the least understood of all environmental systems. For purposes of describing the nature of the problem and the research needs, the following outline is useful:

1. Hydrologic, hydraulic and geologic factors involved in the development of the physical characteristics of estuarine zones.
2. Biological and chemical factors which influence the physical as well as the ecological characteristics of estuarine zones.
3. Specific, man-made pollutional factors and their effects.
4. Socio-economic and institutional factors resulting from man's occupance of estuarine (and contributory) regions and his utilization of estuarine resources.

It should be emphasized, of course, that all of the factors and processes involved in the above list are inseparably interrelated, as are the factors and processes in all natural and man-made environmental systems. Nevertheless, the four categories are useful as a means of organizing a more detailed discussion of the nature of the problem with which we are concerned.

NATURE OF THE PROBLEM

Hydrologic, hydraulic and geologic factors

The hydrologic, hydraulic and geologic factors of an estuary are in large measure a product of the hydrology, hydraulics and geology of the tributary streams, groundwater aquifers and contiguous coastal zones, including the continental shelf. Estuaries are geologically recent features, being in part the result of sea-level change due to the melting of polar ice caps and in part the result of a never ending, continually changing process of sedimentation, scour, wave and tide action, and longshore currents.

The hydraulics of estuaries is complicated by the mixing and interaction of two flow regimes--the fresh-water river and the salt-water ocean. It is affected by seasonally as well as diurnally changing tides, by floods and hurricanes, by shifting tidal flats and shoals, littoral drift, and, of course, a variety of man-made structures and flow-regime modifications. The hydraulics of an estuary is, in the most extreme sense, an unsteady state.

Sedimentation, bed movement and scour processes are complicated by all of the hydraulic factors listed above plus chemical and biological factors such as those which result in flocculation and precipitation of clays, changing of grain size, and pelleting of muds. In some instances they are seriously affected by channel dredging and land-fill operations.

Biological and chemical factors

Physical effects of biological and chemical factors include an exchange between minerals, organics, and water; silicate alterations; iron sulfide precipitation; and scavenging of sulfides and other nutrients, leading to marked changes in the chemistry of water, including dissolved gases. Both micro- and macro-biota are important in controlling water chemistry.

Ecological effects are especially significant with respect to estuaries as sport and commercial fisheries and as habitat of birds and mammals. All these, plus thousands of other kinds of biota are involved in an ecological community which is extremely sensitive to natural and man-made changes in the physical and chemical characteristics of estuaries. Thus, time is an important variable in any study of estuarial ecology.

Man-made pollution

Natural sources of pollution have always created problems in estuaries. Problems of color, low dissolved oxygen and relatively high bacterial counts, for example, are associated with swamp drainage during periods of low fresh-water inflow. The effects of natural pollution are usually insignificant, however, in comparison with the effects of man-made pollution.

Man-made sources of estuarine pollution are numerous in kind as well as quantity. They consist of municipal wastes, both treated and untreated, and industrial wastes of many kinds. Major sources of industrial wastes include paper and pulp mills, textile mills, chemical industries, food-processing plants, petroleum operations, strip mines, mine drainage, nuclear energy operations, thermal-power cooling facilities, and shipping operations. Other man-made sources of pollution include channel dredging, earth movement for construction operations, agricultural chemicals, and oxygen-deficient water releases from upstream reservoirs.

Some of the effects of pollution are easily perceptable and, therefore, objectionable in terms of standards of acceptance which are related to appearance, odor, taste, and the preservation of higher forms of animal life. Other effects, including some of the economic effects, are pervasive but subtle. The effects of pollution on estuarine fisheries, for example, are cumulative and frequently irreversible. Chemical wastes, often originating far upstream from the estuary, can be toxic to fish, mollusks, and crustaceans, or to the aquatic microorganisms upon which they subsist. Wastes discharged into the estuarine environment can also produce objectionable tastes and odors as well as toxic effects on food fish and shellfish harvested for human consumption. The end result can be the virtual destruction of sport and commercial fisheries and all associated industries, including recreational developments. The observed economic effects of an increasing number of such occurrences have been widespread and impressively large.

Socio-economic and institutional factors

Some of the most serious problems related to the management of estuarine resources stem from the fact that estuaries have nurtured concentrations of population and industry which are dependent upon estuaries as major centers of food production and commerce. Sea-going vessels use estuarine harbors and dock facilities as natural points of contact with inland waterway systems and land-transportation networks. Historically, estuarine regions were of primary importance to the development of our Nation. However, historical and land-use practices, institutions, and economic development patterns have in some measure preempted optimal management of estuarine resources when viewed from today's perspective. It follows that remedial measures as well as preventive measures will be important parts of a comprehensive national estuarine resources management program.

Socio-economic factors of critical importance have developed from the relatively recent emphasis on outdoor recreation, including fishing, hunting, and water-contact sports. Emphasis on the preservation of natural beauty and on esthetics and the amenities in general will have an increasingly significant effect on programs and institutions, especially those concerned with land-use patterns and environmental quality control measures. This trend has developed despite conflicting opinions regarding the optimal use of the resources. It is very important, of course, that control measures be carefully and deliberately considered in the light of their effects on existing policies and institutions as well as the people and the economy of the region.

A NATIONAL ESTUARINE MANAGEMENT PROGRAM

Nature of the program

An adequate national program for the conservation and utilization of our estuarine resources will not consist solely of a water-pollution control program based on water quality standards and enforcement procedures. Neither will it consist solely of a large-scale rehabilitation program based on the relocation of population centers and industries and radical changes in land-use patterns. Nor will it consist solely of a prolonged program of data collection. The national program requested by Congress in Public Law 89-753 must, in fact, include some measure of these things and much more. But, most importantly, it must be a comprehensive and a coordinated program, based on the realization that estuarine zones, including contiguous and contributory regions, are immensely complex environmental systems, in which all resources and their associated processes, plus man, his activities and his institutions, are intricately interrelated. Specifically, it must take into account the essential harmony between man and industry as well as man and nature, and it must acknowledge the importance of coordinated participation by all of the affected jurisdictions and by all relevant sources of information and expertise.

Data collection, compilation and retrieval

Although data is not an end in itself, it is an essential prerequisite to planning, developing, and monitoring a well managed estuarine system. An effective and efficient data collection, compilation and retrieval system must be designed in the light of the stochastic nature of most of the data and the deterministic or statistical nature of most data applications for attainable objectives. It must also take into account the accuracy and quantity of data needed as well as the relative importance of the different kinds of data needed to attain the program's objectives. Because the kinds of data required are so numerous and so interdependent, the design of the data system will require the use of formal statistical and systems analysis techniques. Compilation and retrieval requirements will be greatly facilitated by maximum utilization of computer technology.

Because of our gross lack of knowledge regarding many of the physical, ecological, economic and sociological processes involved in estuarine systems, and because estuarine systems are themselves essentially dynamic, the design of data collection and handling programs must involve time as a major variable. Feedback from research results and operational experience; predicted and observed effects of man-made physical, chemical or biological alterations; and changes resulting from natural occurrences must be reflected continually in the design of the data system.

Unfortunately, because of our lack of foresight as well as our ignorance of many of the fundamental processes, very few useful data are now in hand.

The foregoing discussion leads to the conclusion that a large part of the National program for estuarine resources management will consist of research. It reveals also that the purpose of this research will be to assist in planning, developing, and administering the program by improving and filling in gaps in our knowledge of the estuarine environment. It is through research that the university community can make some of its most important contributions to the program. Some representative research needs are described in the following paragraphs.

Research needs

Hydrologic, hydraulic and geologic factors. - Some of the effects of these factors on the physical characteristics of estuaries are described above. Suffice it to say that the processes involved are complex and poorly understood. Much needs to be learned regarding the movement and interaction of the fresh- and salt-water regimes in the presence of a movable boundary, tides, waves, and longshore currents. Both physical and mathematical models, supported with field observations, are currently used to simulate this problem in the aggregate. Segments of the problem, e.g., the transport and deposition of sediment in the presence of wave action, can be studied in the laboratory and subjected to more rigorous mathematical treatment. Similarly, the inter-facial flow of water and brine; the dispersion of solutions and suspended matter; time-dependent, physical changes in the behavior of deposited clays; and the fractionation of silt in brackish water are examples of problems which can be studied with a combination of field observations, laboratory simulation, and theoretical analysis. The study of estuarial flow patterns by means of numerical-analysis techniques developed for use with high-speed digital computers, and the use of radioactive tracers to study the effects of tidal motion on the dispersion of pollutants as well as the scour and deposition of bed materials are examples of research which is possible only because of the development of new or refined techniques.

Biological and chemical factors. - The physical characteristics of estuaries are dependent also on poorly understood chemical and biological interactions. Much research is needed to improve our knowledge of the effects of the biota on the chemical and physical dynamics of sedimentation, the behavior and fate of nutrients, and on the oxygen-depletion and reaeration capacity of estuarine waters, for example.

Ecological effects of biological and chemical factors are especially hard to study because of the immensity of the biological community involved and the extremely sensitive, dynamic nature of the ecological system. The effect of pollution, for example, must be traced over time as a modification of normal or natural processes of change, including those processes which might be described as the result of natural pollution. It follows that research on the ecological effects of exogenous pollution would have to be programmed somewhat as follows: (1) the development of a parametric definition of the unpolluted estuary in an encompassing unpolluted ecosystem, (2) identification of those parameters which are most useful indicators of pollution, and (3) predictions, in terms of the selected parameters, of the behavior of the estuary in response to both natural and exogenous changes in the ecosystem. This last procedure would be accomplished with the aid of a mathematical simulation model of the estuarine ecosystem. Finally, if the purpose of the research were to determine the effects of alternative management policies, it would be necessary (4) to establish limiting values of the indicator parameters in the light of appropriate standards of acceptance. A study of this kind would require a combination of field observations, laboratory studies, and mathematical modeling, with continuous feedback between related activities. It obviously would require considerable field and laboratory research capability and an unusual level of technical sophistication. It illustrates research methods needed to investigate many other problems involving the ecology of estuarine systems.

Man-made pollution. - Present knowledge of the amounts and character of pollutants present in estuarine zones and their effects on the estuarine system does not permit us to design the most efficient management program. Thus, our research needs in this field include the development of improved data collection systems, instrumentation and analytical techniques, as well as improved knowledge of physical, biological and chemical processes. Much needs to be learned regarding the effects of pollution on the chemical and physical processes which influence sedimentation, including the formation of sludge banks. Organic wastes deposited in estuaries continue to deplete oxygen resources, thereby reducing the waste assimilation capacity of the receiving waters while also disturbing the entire ecosystem. It follows that methods of determining and predicting benthic oxygen demands are needed as a means of evaluating waste treatment requirements.

Research is also needed to evaluate the immediate and long-term effects of different kinds of pollution on estuarine biota. The poorly understood and potentially dangerous effects of pollutants such as pesticides and radioactivity require special attention. Only if their effects are fully understood can measures be taken to control or render harmless the treated and untreated residuals which are carried into the estuaries. In general, much research needs to be done to develop improved treatment methods for domestic, industrial, agricultural chemical and animal wastes. Methods of preventing or reducing pollution due to soil erosion from cultivated and uncultivated rural areas and from construction sites in urban areas should be developed. Increased research attention should be given to the effects of thermal pollution and the development of efficient, economical alternative means of dissipating excess heat energy released at the sites of conventional thermal and thermo-nuclear power plants.

Socio-economic and institutional factors. - It is not enough to gain a thorough knowledge of the physical, chemical, and biological factors involved in the estuarine environment. Socio-economic and institutional factors are equally important, and there is much that needs to be known about them.

Economic factors, of course, are of primary importance in resource-allocation decision-making processes, but economic factors are inseparably related to human behavioral factors, such as those which influence personal choice, and to political and institutional factors, such as those which are reflected in group action, laws, policies, and traditions. In short, a matrix of socio-economic factors necessarily will be involved in both the planning and the action phases of the program. The mechanisms within the matrix, as well as its influence on other factors and processes are poorly understood. Much research in this area is needed.

Socio-economic factors are involved in the identification and quantification of program-related benefits and costs, both direct and indirect; in the determination of goals and standards (including water-quality standards); in the formulation of alternative measures and plans; and in the comparison of alternatives in the light of program objectives and allocable resources. For all these procedures, we need improved methodology based on a better understanding of the parameters and processes involved.

Research is critically needed to assist in the development of effective organizations and methodology for planning and implementing a national estuarine resources management program. Because regional programs of this kind are necessarily multijurisdictional, and because many existing institutions were conceived in another era, under different circumstances, new, more effective, politically acceptable institutions may have to be devised. Finally, but most importantly, improved methods of measuring public opinion regarding the need for and the consequences of the program must be developed through research. These are only examples of the kinds of research needed with respect to socio-economic and institution factors.

THE ROLE OF UNIVERSITIES

This meeting and the study of which it is a part is concerned with the optimal, comprehensive management of one of our Nation's important natural resources. The problem has been described as an intricate complex of hydrologic, hydraulic, geologic, biologic, chemical, man-made pollutional, and socio-economic factors and processes. The solution of the problem is defined in terms of a national estuarine resources management program. It is concluded that a large part of the program must consist of research which will lead to the development of new knowledge and new methodology.

Because of the nature of the problem itself, a satisfactory national program will be attained only if it is the result of an effective pooling of relevant responsibilities, authorities, talents and facilities. Our Nation's universities can participate in numerous ways, but they will be especially helpful as sources of information and as centers of research competence. A university's most unique characteristic, as exhibited in its research competence, is the result of its being a community of scholars representative of a very large number of intellectual disciplines. Consequently, it has inherent advantages as a location for interdisciplinary research efforts and for highly sophisticated, unusual research facilities. Within the limits of their competence and their resources, universities should be encouraged to participate in the National Estuarine Study and in the comprehensive program which will result from the Study.

The
Soil Conservation Society
of America

"TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE"

P. O. Box 555
Watkinsville, Ga.
February 12, 1968

Mr. Frank J. Silva, Director
Technical Programs
Southeast Water Laboratory
Federal Water Pollution Contract Admn.
Athens, Georgia 30601

Dear Mr. Silva:

The Georgia Chapter and its 350 members are a part of the more than 12,000 members composing the Soil Conservation Society of America.

Along with the national society we in Georgia are dedicated to the promotion and advancement of renewable natural resources conservation to the end that water, soil, grass, forests, and wildlife, in abundance, may be used and enjoyed by mankind forever. Our objectives are to promote and advance all phases of the science of conservation of soil and water resources; to provide a medium for the exchange of facts, experience, and thoughts; and to represent, advance, and protect the standards of the basic and allied sciences of soil and water conservation.

Toward these ends the Georgia Chapter of the Soil Conservation Society of America, in executive session on February 12, 1968, unanimously endorsed the efforts of the National Estuarine Pollution Study in the sincere hope that it will lead to a greater usefulness of our coastal waters to mankind.

The Georgia Chapter of SCSA urges that adequate technical and financial support be given to those individuals and groups which are concerned with the abatement of stream siltation; roadway stabilization and mining spoil restoration, and erosion as a result of urban and industrial construction all of which ultimately have a definite hearing on estuarine pollution.

Further, that nutrient enrichment of our streams and lakes be fully understood at the earliest possible time through adequate support of research into this area so that agricultures real role in pollution can be properly assessed.

Sincerely yours,

A P Barnett

A. P. Barnett, President
Georgia Chapter, SCSA

cc: Frank Craven
Bob Oertel
Wayne Pritchard

Statement by John M. Henderson for Presentation Before Public Meeting on The Use and Management of Estuarine Resources with Respect to Pollution at Jekyll Island, Georgia on 29 February 1968.

I. INTRODUCTION

My name is John M. Henderson[1] and I am a consulting sanitary engineer and scientist. Because of inability to be present at this meeting, I am responding to the kind invitation issued me by preparing this paper for presentation before the meeting. Although I am presently living on the West Coast of this country, during 40 years of practice about 25 years were spent as a Georgia resident, either living in the Savannah and Brusnwick areas or engaged in work which exposed me to the estuaries and related salt marsh systems of the Georgia coast. Still other work has involved the estuaries and salt marshlands of other states.

With this background of acquaintance with local estuarine conditions and as a sanitary scientist, I am well aware of the important biological, hydrological and physical geographical differences which serve to distinguish the ecology of saline esturial waters and their marshlands from that of fresh water areas. As a further reference frame, I might add that from a biological viewpoint, pollution (i.e. impurity), has a far broader significance than is indicated by those narrower definitions which label pollution as representing pollution as something exclusively bad. Pollution, rather is an inherent part of the plant-animal life process as we know it on this planet, without which no such life could continue to exist. The surface waters of the earth play an essential role in this overall process, especially in estuarine areas. Depending on its degree and hydrographic setting, such pollution can be beneficial, harmful or mixed in its effects. Salt marsh systems, for example, are part of a natural land-making process dependent on receiving a supply of nutrients and sediments from inland streams. Within this setting, more pollution in the form of aquatic nutrients, rather than less, might well enhance the wild life and economic resources of some salt marsh systems, comparable to the fertilization of farm ponds to improve fish yields as recommended by the U.S. Soil Conservation Service and practiced by many farmers. Conversely, however, any such concept that pollution is beneficial cannot be extended to clearly harmful procedures which would clearly adversely affect the ecology of tidal tributary streams such as the mass discharge of certain types of industrial wastes or of untreated or inadequately treated sewage from sizeable aggregations of people. Also, it is recognized that a given supply of nutrients which may be found not only beneficial, but importantly necessary, to a salt marsh system exposed to twice-daily 6-ft tides can be adverse in an 18-inch tidal range area or in some inland lakes and that the ecology of warm water estuarial areas is different from that of cold water areas.

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[1] 6401 Shane Place, San Diego, Calif. 92115.

Having established a general approach to estuarial pollution and ~~their~~ salt marsh systems such as exist extensively along the Atlantic and Gulf coasts, the main purpose of this presentation is to concentrate on one aspect, namely: POLLUTION CREATED BY MAGIC NUMBERS. Because time doesn't permit telling the whole story on which this title is based, the rest of this presentation summarizes a much longer manuscript.

II. SUMMARY OF PAPER

A. Scope

This paper is concerned with filth-borne (enteric) disease occurrence and hazards of man and related procedures and standards for evaluating "safe" and "unsafe" waters for recreational use and for shellfish growing and harvesting (oysters and clams), all in saline natural estuarial waters. The term "filth-borne (enteric)" disease is intended to include all diseases contracted as a result of sewage pollution or other fecal pollution and not merely those diseases which are confined to the gastro-intestinal tract of man.

These two subjects, both relating to human disease, one pertaining to recreational water use and the other to shellfish production and consumption, have points in common and also distinct differences between them. The common points will be considered conjointly.

B. Disease Transmission History

1. Recreational Water Use in Natural Waters.

Based on available information, the number of reported cases of enteric disease contracted in the U.S. through use of natural recreational waters has been zero during the past 20 odd years. During this period there has been a national communicable disease surveillance network in operation, spearheaded by the National Communicable Disease Center and taking in state and local health departments throughout the country. This network pays special attention to noteworthy and newsworthy disease episodes involving a handful of cases as well as more important occurrences. Nevertheless, there is always a possibility that in a nation of 200 million people, a few cases may be undetected in terms of mode of transmission, with a greater possibility of a larger number of undetected non-disabling communicable disease "illnesses" of a nature not requiring medical attention. There have also been rare episodes of illnesses of a non-enteric type which have been contracted from non-human animals through the recreational water route and which come under the category of epidemiolog~~y~~ical curiosities. These statements apply to all natural waters in this country and not merely to estuarial waters and the negative enteric disease experience has existed in spite of the fact that an undeterminable, but large, number of people have used recreational waters for body-contact sports in which the sanitary quality of the water by any prevailing yardstick would be considered unsafe.

By comparison, in one year alone, there were over 5000 cases of non-occupational drownings, largely in connection with recreational water use ~~in~~ of natural and artificial waters. Among other environmental hazards, there were also nearly 20,000 deaths from falls, nearly 8,000 from fire and explosion and nearly 2 million disabling injuries and 53,000 deaths from automobile accidents.

2. Shellfish

The transmission of enteric disease by consuming raw shellfish (oysters and clams), harvested from polluted sources was first established in the U.S. 74 years ago at Wesleyan, Conn. Subsequent records have included "outbreaks" ranging down to a single fatal case, such as at New Haven in 1948. ~~Outbreaks~~ Occurrences in recent years have consisted of 85 and 495 cases of infectious hepatitis respectively in the Pascagoula and New Jersey outbreaks cerca 1961.

While no complete count of the number of cases and deaths has been made for this 73-year period, a reasonable estimate of their totals might be in the order of 5000 cases and 100 deaths, an annual average of around 70 cases and 1 death in an average population of 125-150 million. These figures undoubtedly would be higher if it were not for a system of sanitary certification initiated in 1927.

All but one outbreak was associated with direct, fresh contamination of the shellfish waters with urban sewage from nearby outfall lines.

C. Sanitary Controls Over Natural Area Recreational Water Use and Shellfish Harvesting Waters.

1. Recreational Areas

General experience with the enteric disease potentialities of fresh sewage from community sewer systems serves as an adequate precautionary basis for establishing recommendations and regulations against engaging in whole-body contact sports activities in recreational waters which are significantly polluted in this manner. How far if at all, beyond this point any guidelines or standards should proceed is a question that cannot be determined on any rational basis from U.S. experience due to sheer lack of known instances of enteric disease transmission due to recreational water activities in polluted waters and hence lack of knowledge of the curcumstances surrounding any such occurrences. For this reason it is necessary to draw on British experience.

British experience includes a comprehensive objective epidemiological study made around 1955-59 under the following circumstances: Extensive bacteriologic and epidemiologic studies were made over a period of 5 years in relation to more than 40 popular bathing beaches the waters of the great majority of which were subject to contamination with sewage. Median presumptive coliform counts varied from 4000 to 2.5 million MPN and as many as 40% of the samples contained over 10,000 MPN with 33 different types of human disease organisms identified. Conclusions reached were that, out of a substantially larger number of cases of enteric disease contracted in other ways, there were 4 cases of paratyphoid fever that could possibly have been attributed to bathing in infected sea water. In each case, however, the bathing area was grossly contaminated with visible fecal material.

The Investigating Committee indicated that unless the water is so fouled as to render the bathing beach esthetically revolting, it would seem that public health requirements are reasonably well met by the present British policy of improving grossly insanitary beaches and preventing as far as possible pollution of the waters with disintegrated fecal matter. The Committee carefully avoided setting up any system of numbers of bacterial index organisms as a measure of water contact disease hazard.

Recommendations and regulations in the U.S. pertaining to the sanitary safety of natural recreational waters until very recently have been determined mainly by appraisal and evaluation of possible disease transmission hazards, in short by sanitary survey procedure. Results of bacteriologic tests for so-called index organisms have been one category of a number of pieces of information fed into the mix, for use as a guideline or clue with a status comparable to that of an unidentified tire print found near the scene of a crime. In some cases, numerical values were adopted as guidelines but not as "standards". Their status as "standards" (i.e. independent values) was avoided for a number of valid reasons but chiefly because, by themselves, they provide no direct evidence of significant enteric disease hazard in recreational waters.

However, as a result of recent Federal legislation and its administrative implementation, it became mandatory in 1967 for each state to establish a set of water pollution "standards", including bacteriologic "standards" for various types of water use, such as recreational uses, with each set of state standards to be approved by the FWPCA.

The FWPCA position is that fecal coliform values of 200 and 1000 MPN should be adopted respectively for swimming (i.e. primary contact), and for fishing-boating waters with the proviso that lower limits should be adopted where feasible. The fecal coliform test reveals the presence of "index" organisms which originate in the feces of all warm blooded animals including man in varying numbers and there are indications that they also multiply in the guts of cold blooded animals, such as fish, when water temperatures exceed 68°F.

Applied to many saline tidal estuarial waters along the Georgia coast as well as other states, the practical significance of the fecal coliform test is that it in effect represents a method of selective census taking of wild and semi-wild animal life on marsh islands, their salt marshes and in the tidal channels themselves. The test is termed selective because different animal species vary in their fecal coliform output, thus creating a bias. For example, one duck equals 5½ men and on a body weight basis a 5 lb duck is 175 times as productive of fecal coliforms as a 150 lb man. With a herd of semi-wild hogs (per capita fecal coliform production 8.9 billion/day) feeding in the water on salt marsh grass, of which they are very fond and an adjoining flock of ducks (output 11 billion/capita-day), plus a miscellaneous assortment of raccoons, otters, deer, squirrels, field mice etc. in and adjacent to a tidal creek classed as "primary contact" recreational water, you are invited to calculate their effect on a "standard" of 200, which is equivalent to 53,000 organisms/gallon of water.

The adoption of such coliform values as "standards" i.e. absolute values, rather than as clues which may turn out to be meaningful or meaningless, represents the first example in this paper of "pollution created by magic numbers". This label takes into consideration the lack of evidence of enteric disease transmission in natural recreational waters over a long span of years among 125-200 million people, even in the presence of significant sewage pollution. Such fecal coliform standards are, of course, "light-years" away in distance from British practices based on actual disease transmission.

It should be mentioned, however, that any adverse impact of the FWPCA recommended "standards" on estuarial recreational water use applies to coastal states other than Georgia because the Federally approved recreational water fecal coliform "standards" of the Georgia Water Pollution Control Board are 5 times higher in numbers than the Federally recommended "standards". Commendably, the Georgia regulations contain protective features against use of recreational waters polluted by nearby community sewage as distinguished from bacteriologic "standards".

2. Shellfish Harvesting Areas.

Oyster sanitation activities in the U.S. are administered collaboratively by the Federal Public Health Service and State Health Departments. They are not an FWPCA responsibility nor one of the Georgia WQCB. The regulations and "standards" are Federally promulgated for oysters in interstate commerce but are generally applied by the states to all commercial oysters.

The oyster bacteriologic "standards" for harvesting areas differ from the preceding recreational water "standards" in that, based on latest available information, the ceiling count is 70 rather than 200 and 1000 and the Total Coliform test is used instead of the Fecal Coliform test. Both are tests for "index" organisms as distinguished from disease organisms. In Georgia, all publicly owned shellfish growing waters are also recreational waters and hence subject to both sets of "standards".

The principal differences between the 2 sets of bacteriologic "stanards" is ~~that the oyster standard is~~ that the Total Coliform test of the oyster "standards" is for index organisms of non-fecal as well as fecal origin. The non-fecal coli family of bacteria grows in many types of organic residues, chiefly located in or on soil, from where they are washed into natural waters by runoff from rain. They are ubiquitous in nature and are abundant throughout the world in forests, grasslands and even in sparce numbers in desert soils. One member of the family grows in a pH range of 4 to 9, indicating the wide variety of conditions under which it grows. Essentially, the non-fecal coliforms provide an index of the existence and luxuriance of plant life on this planet and are an inherent part of the ecology of the Georgia salt marsh island system. Total Coliform test results exceeding the "standard" can be entirely composed of Non-Fecal organisms but more commonly are a mixture because at least minor forms of warm blooded wild animal life generally exist wherever there is a plant food-insect community. Moreover, some 85% of the Total Coliforms in samples collected from natural soil settings and counted in test results are "false positives", based on an extended series of research tests, and are not even "Total Coliforms".

Although there is a "savings clause" in the Federal "standards" which permits Total Coliform counts exceeding 70 to be ignored where there is no sewage pollution "hazard", there is always a far-out possibility that such onsite pollution might conceivably occur as long as oysters are harvested by man rather than by raccoon, and for this and other possibilities, at least one state authority is reluctant to supersede test results which exceed the "standard." Yet, the pattern of all known instances of shellfish disease outbreaks has been keyed-in with gross sewage pollution from community sewer systems.

The practical effect of the "70 Total Coliform Standard" has been the disapproval of extensive shellfish harvesting estuarial waters in Georgia and the virtual disappearance of an active oyster industry in at least one county. At the same time, some other disapproved areas warrant disapproval on any more rational basis.

This situation is cited as a second example of "pollution created by magic numbers" and concludes this paper.

Statement of Horace P. Morgan 1/, submitted for the record at a public meeting held by the Federal Water Pollution Control Administration, at Jekyll Island, Georgia, February 29, 1968.

Along the 100 miles of general coastlines, or the 2,344 2/ miles of Georgia's detailed tidal shoreline, most people have traditionally looked at tidal marshes, bays, sand bars, and islands as places which look better and contribute more to personal and the State economy if they somehow could be changed. And change them we have in the past decade, although not yet on the scale of an adjacent State where at least 60,000 acres (or 7.5 percent) of some 1,051,200 acres of estuarine areas have been changed to biological deserts. This has been brought about by diking, draining, dredging, filling, spraying and polluting the vanishing shorelines. In each of the 25 States which have estuarine areas, it is evident that the same story can be told.

Thoughtful citizens in this State are beginning to think this is likely to occur along Georgia's coast. This is evidenced by an editorial in the December 12, 1967 issue of the Atlanta Journal entitled, "Ruining a Salt Marsh Is Like Burning Money." The editor has granted permission to reprint the editorial and it is an attachment to my remarks.

What good are estuaries? Why not use them for boat marinas, private or commercial construction sites, places to build airports, highways, and other developments? Through dredging, draining and filling, it is easy and inexpensive to turn these biological complex estuarine areas, which are neither land nor sea, into either one so people can live and work on them. Or

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1/ Executive Director, Resources Advisory Board, Southeast River Basins, Room 402, New Walton Building, Atlanta, Georgia 30303.

2/ Statistical Abstract of the United States, 1961, page 160. Figure obtained with recording measure on largest scale maps and charts available. Shoreline of bays, sounds, and other bodies of water included to head of tide-water, or to point of where they narrow to a width of 100 feet.

convert them into summer cottage colonies where city people and the affluent society can get a place in the sand and sun. Isn't the reclamation (and destruction) of the estuarine areas really a measure of progress and prosperity?

What should the builders, dredgers, developers and local officials consider in looking for extra tax dollars in equating their proposals with the values of undamaged estuarine areas? Among these values are:

FOOD VALUES

Many people feel--as I do--that agriculture can and should be supplemented by food production from the sea. We are not necessarily talking about fish alone. Estuarine waters comprise the last great hope for feeding a hungry world population.

In their unspoiled state, estuaries and the salt marshes that often border them are among the most naturally fertile areas within the State. Some of the areas reportedly can produce from 60 to 240 pounds of basic food per acre per day. An extensively used tame hay contains 2.9 percent digestible proteins; salt marshbay cordgrass (Spartina patens) contains 3.3 percent. Is it any wonder that the several marsh range cattle operators in Georgia greatly cherish their marsh range holdings?

Salt marsh nutrients are just as vital for growing seafood as grain is in growing beef. An acre of salt marsh produces other food nutrients, such as 1,000 pounds of carbon per year, and 500 pounds of sugar per year, produced by microscopic plants. The tonnage of vegetation that Georgia marshes produce per acre each year is unrivaled by any other natural soil in the State and it is difficult to equal, even in the extensive agricultural areas using commercial fertilizers.

The Sapelo marshes of Georgia are said to produce in a given area nearly seven times as much organic matter as a comparable area in the waters of the Continental Shelf, and six times as much as a same-sized area in the average wheat field.

PROTECTION VALUES

A traditional, esthetic beauty to our coastal towns and cities is provided by estuarine areas and tidal marshes. They are natural barriers to erosion. A coastal hurricane in recent years caused significant damage to man-made structures to the shore at Jekyll Island, Georgia. Bulldozing and pushing sand dunes into the ocean earlier had destroyed a protective barrier. Those towns along the Georgia coast behind marshes, or in areas not on former marshland, were much less affected. These areas acted as a barrier and prevented excessive flooding and property damage.

RECREATION VALUES

For those citizens in the State, or visitors, who boat, hike, fish, camp, hunt, watch birds, or just want to commune with nature and escape the tensions and pressures of the jet-atomic world, estuaries have inestimable value. They provide important nesting, resting and feeding places for migratory and non-migratory waterfowl. They are the home of a unique and extremely fascinating ecological community of living things. These values may not be measurable in dollars, but they are important values.

BIOLOGICAL VALUES

It was distressing to read an article about this meeting appearing in the Atlanta Journal and Constitution, Sunday, February 18, 1968. The article stated that, "Georgia estuarine areas are of swamp origin which precludes shellfishing, recreation or fishing uses, the government said."

Some estuaries are on the spawning grounds, nurseries or growing-up sites for several species of commercially important shellfish, crustacea, and finfishes. Shad must pass through estuaries on their way from the Atlantic Ocean to fresh-water Georgia streams to spawn. A large percent--maybe 80 to 90 percent--of the total harvest of seafood taken by American fishermen comes from the Continental Shelf. About two-thirds of the species involved depend in one way or another on estuaries. Thousands of sport fishermen annually enjoy estuarine and coastal fishing and open-ocean fishing along the coast of Georgia for estuary-related species.

I read recently about experiments which resulted in annual harvests of shellfish that were worth up to as much as $26,850 per acre in the market place.

WHAT SHOULD BE DONE

The State of Georgia does not have adequate legal devices to protect estuaries, especially from the loss of intangible, or at least monetary, values, of which many are of public interest. Enactment of legal devices which the State can use in estuarine protection should be considered.

Regulations should be issued by the appropriate State agency or by State law if necessary, to govern dumping of dredgings, earth, garbage, or other refuse into any estuary or the waterways along the Georgia coast. The State needs to develop effective machinery to protect estuarial values in the face of impending, tremendous pressures to turn short-term profits on residential and industrial real estate developments in estuarines.

The State should cooperate--financially and with man power--in a nation-wide inventory of estuarine areas, in consultation with the other States and the Federal agencies.

An approved State plan or local plans, as applicable, should be prepared and implemented to prevent further pollution and provide corrective measures in estuarine areas.

The State of Georgia and political subdivisions, and the Federal Government should acquire and administer estuarine areas where studies reveal such acquisition and administration to be desirable. This approach represents a recognition that both the State and the Federal Government must share the responsibility in this most important area.

But before commencing a broad estuarine land and water acquisition program, studies should identify the areas requiring protection, the most appropriate agency or entity of government to assume responsibility, and the best course of action for each particular estuarine area. Action based on insufficient knowledge is usually action later regretted and estuarine zones are far too important for the well-being of our citizenry to have any future regrets. It is, therefore, imperative thatknowledge of estuarine zones be increased. What little we do now possess is fragmented. A broad and thoughtful study of the entire system of estuarine zones is needed.

Hopefully, the relevant expertise both inside and outside the government will be used to insure that the best minds are brought into the study under the provisions of P. L. 89-753, the Clean Water Restoration Act of 1966. All the answers are not likely to be in the report due to be submitted to the Congress by November 1, 1969. Estuarine studies must be a continuing series of up dating efforts to be carried on well into the future.

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Attachment to remarks of Horace P. Morgan submitted for the record at a public meeting held by the Federal Water Pollution Control Administration at Jekyll Island, Georgia, February 29, 1968.

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The Atlanta Journal
"Covers Dixie Like the Dew"
Since 1883
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EDITORIALS 18-A DECEMBER 12, 1967

ACTION IS NEEDED

Ruining a Salt Marsh Is Like Burning Money

By JACK SPALDING

THE GEORGIA coastal marshes were made famous by a poem of Sidney Lanier's. The sweep of the marshes between the mainland and the sea islands, with occasional glimpses of the ocean, is beautiful.

Since Lanier we have regarded these marshes as an aesthetic asset. Attempts to encroach on them, particularly at Brunswick where Lanier was inspired to write, have been resisted more or less successfully by lovers of beauty.

For a long time we have known these marshes also had commercial value. It was suspected that they had something to do with the production of shrimp and crab and other sea harvests. We have been learning more about the important part these marshes play in ecology through the work of the University of Georgia's research station on Sapelo Island.

These marshes truly teem with life. They are nurseries for young fish and crustaceans and grow food for them. They also support bird and animal life. They are, in short, treasures.

Do we value them highly enough? We do not. Occasionally the papers carry stories about plans to use them for other purposes. Any purpose which would destroy their natural function is bad. Anything which will upset the delicate balance of nature here is hurtful. Poor old nature has taken quite a battering at our hands recently and is beginning to spit back. We are beginning to pay for our carelessness in polluting our streams and our air and in otherwise poisoning our environment.

* * *

THERE ARE many agencies, local and federal, concerned with this mess we are making. It is the thesis of an article in the Dec. 11 issue of Sports Illustrated that we are not doing a good job and that the whole conservation setup needs reorganizing.

Anyone familiar with the continued spread of pollutants and poisons and the decline of the quality of life in this country must agree. We have a lot of conservation outfits, sure. But what are they doing? Is it possible that some even are helping make the situation worse?

* * *

THE GEORGIA coastal marshes are notable for their sweep and size. They form a magnificent (and fortunately, a relatively untouched) sample of marshlands which extend from New England to Florida. Ours are extensive, and therefore should be guarded for our benefit as well as for the preservation of species of sea life which range the whole seaboard.

Sports Illustrated recommends congressional legislation to protect all these marshes, calling them "the most valuable and productive areas on the North American continent . . . up to six times richer than the average wheat land. Yet nowhere has destruction been more savage or blind than along our coasts. Destroying wetlands or fouling estuaries makes as much sense as burning down a bank, yet the destruction continues at an appalling rate."

Destruction of the marshes and fouling of the estuaries have resulted in a dramatic decline in fish, for many of our best food and game fish depend upon these marshes and estuaries. Fish are found in the ocean, sure, but only because the marshes are their nurseries and larders. Destroy the marshes and you have broken the life cycles of many species.

The article calls the coastal fisheries of the United States the greatest single wildlife resource the country possesses. It is worth billions of dollars. Yet we allow dredging, filling and industrial pollution.

So far Massachusetts, which prohibits the alteration of a salt marsh, is the only state to move to protect this treasure. Here in Georgia, we do have powerful sentiment in favor of protecting these marshes, but in the war between sentiment and commerce the latter usually wins.

* * *

POETS HAVE made our marshes famous. Now the scientists are beginning to instruct us in their value to us and the nation. Unless other states, including Georgia, follow the example of Massachusetts in protecting the salt marshes, congressional action may be both desirable and necessary.

Georgia Recreation and Park Society, Inc.

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NPRA Representative
Virginia Carmichael (1966-69)

February 28, 1968

Mr. John R. Thoman
Regional Director
Federal Water Pollution Control
Administration
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Atlanta, Georgia 30309

Dear Mr. Thoman:

In response to your letter of January 12, 1968, regarding the study of pollution problems in estuarine areas, I would like to submit the enclosed "position statement", of our Society.

We would be most happy to provide help and assistance on this study project, and I assure you that we are greatly interested in this matter.

Sincerely,

James A. Colley, President
Georgia Recreation and
Park Society

JAC:mw

An affiliate of the National Recreation and Park Association

February 28, 1968

Estuarine Policy Statement
(Georgia Recreation and Park Society)

Recreation is riding the crest of a tidal wave that will soon engulf us in a "golden age of leisure", the likes of which have never been seen before in this great country.

Those of us who are charged with the responsibility of providing creative leadership for the citizens of our communities, and our state, in seeking quality recreational experiences are deeply concerned with the development of a sound Estuarine Policy for the State of Georgia.

Since one of the major facets of your national estuarine pollution study is an "analysis of the economic and social values of the estuaries", (and estuarine zones) we would like to address our concern to this particular problem.

First of all, we are concerned with the need to provide adequate recreational resources for utilization by our constituents. Utilization of available resources is only possible, of course, if adequate access to these resources is available to potential users and utilization is only desirable if the resources are of high quality and possess favorable aesthetic traits such as freedom from pollution of any sort.

Secondly, we would point out to you that the estuarine resources of this state are somewhat limited and that the most important problem being faced is the development of a state policy governing the use of these limited resources. This policy must give consideration to the use of these resources for: commercial navigation, flood control, power generation, the fishing industry, sport fishing and hunting, conservation, science education and other recreational pursuits.

State policy must strike a proper balance between the economic and social uses of this natural resource. This coastal area of the state is going to be further opened up for exploitation by the construction of Inter-State Highway (I-95) and feeder roads that will follow in the wake of its development. This means that we are going to have an in-migration of population, new industry and heavy pressure for further development of the tourism industry and tourism services in the area.

While a dense resident population and the demands of a tourism industry are not incompatible with the recreation needs of Georgia's population, it does mean that recreation opportunities are going to have to be safeguarded in the public interest and that they must receive a heavy priority as the value of our estuarine resources are weighed.

One other factor that we must point out to you is the tremendous educational potential of these resources. Those who have hiked and boated through the "Marshes of Glynn", or comparable areas in other parts of the country, can appreciate the educational opportunities contained therein for science education, conservation education, and outdoor education. One section of this marshland has been considered for possible inclusion in an outdoor recreation experiment station.

Other material pertaining to the utilization of this area is included in the following pages of this report, however, I would like to conclude my presentation with this statement: The Georgia Recreation and Park Society is composed of professional recreators with a multitude of skills in the many disciplines related to recreation and if we can be of service to you and help in support of the estuarine program we would be most happy to do so.

Quality of the Environment

Is it too late to stop the ruin of our waters, our open land, our air, our scenic beauty? Today scientists speak not of conservation or our natural environment but of restoration, revegatation, redevelopment and creating a new environmental design to supplant the ugliness that besets our landscape and the pollution that destroys the quality of our resources.

If recreation is to be the renewal of our inner resources then there must be a quality to our environment that will stir men's souls and foster a creativeness of spirit beyond which we have ever achieved before.

Coastal Georgia is very nearly virgin in developed recreation uses. There are two public facilities of large size (Savannah Beach and Jekyll Island Authority), and only a few secondary (sometimes entirely unpaved) roads which reach the outer shoreline of the Barrier Islands. There are four Federal refuges for wildlife along the coast, but none for people (Unless we count a National Monument, Fort Frederica). The marshes themselves are popular for hunting wildfowl and fishing, but up to the present have served as an effective barrier to easy development of public facilities along the coastline. There is some indication that the marsh areas within commuting distance of Savannah are growing in popularity as residential sites.

Georgia is a well-watered state with ample opportunity in her terrain for large impoundments. There are seventeen major reservoirs and three smaller ones, owned by private and public agencies. (The Corps of Engineers administers six of them, the Tennessee Valley Authority three, and the rest by several power companies.) There are about 3,500 miles of large warm-water streams and about 700 miles of cool-water streams in the state. The coastline is heavily indented and creates about 1,000 miles of shoreline area suitable for salt-water fishing.

The state of Georgia has approximately 766 miles of navigable waterways. These lie mainly along the western and eastern perimeters of the state. Commercial navigability implies a head of navigation of three-foot minimum channel.

These waterways have followed the pattern of most of the states water bodies by serving as multiple-use areas. They attract and support various industries in their areas, provide power, and are used as recreation areas. These different uses have resulted in conflicts between recreational users and commercial navigators, irrigation interests, and power companies. Until recently recreation has more or less taken a back seat to these other interests. But now recreation users are asking for (and getting) more consideration from industry, commercial navigators, et cetera.

> Use as a waterway can have both a detrimental and a beneficial effect on their utility for recreation. If navigability results in heavy traffic and pollution, the effect on recreational uses is obviously detrimental. On the other hand, navigability of streams may permit the passage of larger pleasure boats, perhaps large enough for open water use, farther into the interior in order to reach berths more desirable for more convenient, as well as offering impoundments for water sports like skiing.

Much recreation, of course, takes place on the streams above the point of commercial navigability on these streams and the types of recreation are influenced by the structure (dams, locks, etc.) erected on these streams which may enhance or deter recreational potential. The non-navigable portions of these streams may actually have more recreational value than the navigable portions.

Coastal fishing is strongly influenced by tide, weather and season, but goes on all year. In the summer, mackerel, bluefish, dolphin, bonita and sailfish are fished; in the fall, winter and spring, channel bass, speckled trout, and striped bass are popular. Fishing is done from boats in the bays and sounds, and offshore. Surf fishing is also popular when conditions are favorable.

The tidal marshes hold something of the same fascination. Such vast expanses of land which defy man's exploitation is an awesome sight. They too are rich hunting grounds, for both the naturalist and the sportsman.

To the present, the marshes have been utilized almost exclusively by sportsmen; their potential for sightseeing is nearly untouched. Because of the slack water, the streams in the coastal marshes are particularly well suited for small manually-powered boats. Boat trails in many places could be easily worked out, and there are two abandoned canals, one at Savannah and one at Brunswick, which have a potential as canoe trails. The use of small boats in this setting is roughly equivalent to nature hikes in drier areas, and no less rewarding in terms of flora and fauna observable.

Public control of sufficient shoreline length to assure access by large numbers of people is essential, and must be achieved quickly, for private control proceeds rapidly along the shores of any desirable water body.

The coastal shoreline is in the same category of need, for at the present Jekyll Island is the only significant developed public facility on the Georgia coast (other than Savannah Beach).

Georgia's Major Navigable Waterways

Channel	From	To		
Savannah Harbor	Port Wentworth	Mouth of Savannah River	30	21
Brunswick Harbor	Wharf of Allied Chemical Co.	St. Simon Light	30	12
Atlantic Intra-Coastal Waterway	Mouth of Savannah River	Mouth of St. Mary's River	12	137
Savannah River below Augusta	Augusta	Upper end of Savannah Harbor	9	196
Darien Harbor	Darien, Ga.	Dobay Sound	12	11
Satilla River	Owens Ferry	Mouth	9	32
St. Mary's River	St. Mary's, Ga.	Mouth	16	5
St. Mary's River	King's Ferry	St. Mary's	10	35
Apalachicola-Chattahoochee-Flint Rivers	Columbus and Bainbridge, Ga.	Mouth of Apalachicola	9	158@

@ Jim Woodruff Dam to Columbus, Georgia

Mrs. Howard W. Nix, Sr.
5182 Peachtree
Dunwoody Road, N. E.
Atlanta 5, Georgia
30305

STATEMENT TO FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, JEKYLL ISLAND, FEBRUARY 29, 1968

Mr. Chairman, I represent a General Interest Group, the General Federation of Women's Clubs, an organization of 11,000,000 members holding membership in each state in the union. Locally, I am president of the Georgia Federation of Women's Clubs with membership of approximately 9,000. From the parent national organization to the local clubs in each state, a very active Conservation Department, including Divisions of Land and Water Resources and Pollution, is engaged.

Through the Conservation Department, we attempt to educate and inform our members of our natural resources and encourage public support to share our concern and effort to preserve and develop these resources.

The specific study of Pollution has been given increasingly major priority during the past few years, especially in the area of polluted air and water in our cities.

However, we must admit that although the pollution problem of the nations estuarine areas is not new and unknown to us, we do need much more information to speak knowledgeably about the subject.

Therefore, this statement shall not attempt to present technical background nor recommendations. It does represent research and use from many sources.

We are aware of the irreparable destruction and pollution of much of the nations estuarine waters adjacent to the American coastline. We are specifically aware of the need to save the 2,000 plus miles of shoreline of the State of Georgia.

Conservation means the wise use of resources. Georgia's estuaries and associated marshes are among the most fertile areas on earth. They are of great importance to the states economy. In the first eight months of 1967, 9 million pounds of fish, shrimp, oysters and crabs, valued at $1,400,000, were taken from Georgia's estuarine areas.

Estuaries support a large sport fishing industry, attracting many fishermen to our tidal waters throughout the year. This contributes to the support of the coastal counties resort and motel industry. Many tourists visit Georgia's estuaries to view their great natural beauty. An earlier visitor was the famed poet, Sidney Lanier, who wrote of the beautiful Marshes of Glynn. No monetary value need be put on the aesthetic worth of our estuaries; they represent a priceless, irreplaceable natural resource.

We believe that our estuaries should be conserved and protected as a valuable resource important to the total ecology of man and his beneficial animals.

We know that to pollute means to despoil and destroy. Unfortunately, in past years we have permitted pollutants from municipal and industrial wastewaters to seriously degrade two of our larger estuaries. Inadequately controlled dredging operations for land developments, marina construction, and channel maintenance have damaged or destroyed fish, shellfish and other equatic life.

We believe in giving strong support to our State water pollution control agency to enforce abatement of existing pollution from sewage and industrial waste. The federal government should provide considerably more construction grant funds for municipal sewage treatment plants. The State should appropriate substantial funds for similar construction grants to towns and counties.

We believe in research. Estuarine tidewater and marsh ecology is a fairly new science. All too often, we reach an understanding of the value of a natural resource only after the resource has been damaged beyond repair or reclamation. To quote our national GFWC Chairman of Conservation, Mrs. Marion T. Weatherford of Oregon, "we should never destroy one natural resource in the development of another."

For this reason, we would like to see Federal and State funds provided to the State University System, the Marine Institute on Sapelo Island and to the State Oceanographic Institute for research and development relating to the protection and upgrading of our estuaries. Though the total area of unpolluted estuarine waters has shrunk considerably in the past 25 years, we still have many square miles of high quality waters in our bays, sounds and inlets. Strong measures should be taken to prevent any increase in pollution of our coastal waters.

On the other hand, the problem of water pollution is not just an engineering or a scientific enigma to be solved by the professionals alone. Education in the use of resources will cut down the need for restrictive laws, while building public support when regulation is necessary. To some extent, all of us are polluters, In the end, it will be solved by people who are willing to face up to the need to achieve, through education, research and public information, good conservation and the wisest and best use of all our natural resources.

I thank you for the opportunity to represent my organization in presenting this statement.

Mrs. Howard W. Nix, President

Georgia Federation of Women's Clubs
445 HENRY GRADY HOTEL
P.O. BOX 14161
ATLANTA, GA 30301

YWCA

National Board of the Young Women's Christian Association of the U.S.A.

600 LEXINGTON AVENUE
NEW YORK, N.Y., 10022
212-753-4700
CABLE: EMISSARIUS, N.Y.

February 28, 1968

Mr. Frank Silva
c/o Stuckey's Carriage Inn
Jekyll Island, Georgia

Mrs. Robert W. Claytor
President

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Vice President

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Vice President at Large

Mrs. Ralph A. McCanse
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Chairman, Central Region

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Vice President,
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Mrs. Chester Root
Vice President,
Chairman, Western Region

Mrs. Herbert P. Catlin
Secretary

Mrs. Dallas B. Sherman
Treasurer

Mrs. Robert R. Penn
Assistant Treasurer

Miss Edith M. Lerrigo
Executive Director

Dear Mr. Silva:

I am happy to be able to make a statement on behalf of the Southern Region of the National Board of the YWCA of the U.S.A.

The YWCA has had a long interest in conservation and recreation dating back to the late 1880's. At that time it was concerned with working conditions and vacations with pay for women workers. Its efforts to help these women find renewal in the out-of-doors led to the first camp established for women in industry. Through the intervening years we have continued to work vigorously to improve the quality of the environment in which women and their families seek fulfilled lives. In this effort we have recognized the importance of the close interaction between human life and the world of nature. This interaction takes on increasing importance today as an urban, technological society creates vast new problems. We are using up our natural resources at a rapid rate. Increasing population and urban sprawl has created new demands for open space and for healthful and readily available recreation facilities. At the same time technology has brought increased leisure within the range of millions.

At our 1967 National Convention the YWCA of the U.S.A. adopted its newest statement which includes the following words:

"A BETTER ENVIRONMENT

Women are the traditional guardians of the environment in which their families live. As the social environment has spread out from the home to the community and the nation, women's concern has followed close behind. No individual and no family can any longer alone control the air they breathe or the water they use, the way they live and move about together, the physical and cultural setting in which they seek their satisfaction, or the heritage they will leave to those that follow. These have become social questions requiring social action for their solution.

We, therefore, favor those measures which assure the full utilization of all our resources - natural, economic, social, and cultural - to create a common environment in which each individual may develop and exercise his fullest potential for creative living whatever his ethnic background, economic circumstances, or geographic location. Specifically, we support measures to achieve the following:

Programs to restore and maintain the purity of our air and our water resources.

Programs to develop and conserve the beauty of our man-made and natural resources, including the public acquisition of accessible recreational areas, the preservation of wilderness areas for educational and inspirational values, and the protection from disfigurement of our public places - including highways."

YWCA members in southern states share in their organization's concern for conservation. We support the need for concerted citizen action and government assistance in stemming the fearful results of water pollution with its consequent damage to wild life, to recreation, and all other beneficial uses of water.

Both immediate and long range planning are needed to include such issues as: control of industrial wastes, effective treatment and disposition of sewage from cities and from marine traffic, preservation of wild life and wetland areas, prevention of erosion and the securing and maintenance of public recreational areas adequate for a growing population.

Sincerely,

Eileen E. Muir
Correlator
Southern Region Office
National Board of the YWCA of the U.S.A.

EEM/eq

The Theory of the Estuarine Ecosystem
In Relation to Use, Management and Pollution*

Eugene P. Odum
Institute of Ecology, University of Georgia

The University of Georgia is contributing to the study and development of the estuaries and sea islands which are among the state's most unique, widely heralded and valuable natural resources. Agriculture, Forest Resources, Landscape Architecture, Biological Sciences, Geology, Geography, Community and Area Planning, and the Marine Institute at Sapelo are but a few of the University schools and departments which have an interest in and knowledge about various aspects of the tidewater region. Individuals from a number of departments have prepared statements in areas of their special competence for inclusion in these hearings. It is my task to present a picture of the estuarine region as a whole which hopefully will help in formulating logical plans of development that will avoid senseless pollution and deterioration of human living space such as is even now beginning to bring economic ruin to some parts of the Atlantic coast.

In ecology we use the term "ecological system" or "ecosystem" for an area of the landscape in which sun energy plants, animals, man, water, minerals, etc. interact so as to sustain life on a continuing basis. We find this term useful in the abstract as, for example, in speaking of the interdependence of man and his environment or in the very concrete sense as, for example, when we consider a pond as a descrete unit of nature. The estuarine region can be considered to include sounds, creeks, river mouths, marshes and all those areas where sea and freshwater mix. The estuary is a well defined ecosystem because of the many environmental features that separate it from adjacent upland and open sea environments. Since all things are interdependent in an ecosystem, it follows that we must eventually subject both knowledge and human needs to some kind of "systems analysis", which is a technical phrase for an "evaluation-of-the-whole" procedure, if we are to select the wisest uses and avoid conflicting manipulations. I shall now try to outline in non-technical terms something of what we understand about the estuarine ecosystem.

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* Statement prepared for the field hearings at Jekyll Island, Georgia February 29, 1968, in connection with the National Estuarine Pollution Study authorized by the Clean Water Restoration Act of 1966.

Coastal estuaries and the adjacent alluvial plains,-such as occupy a wide zone along the Georgia coast, -are among the most naturally fertile landscapes in the world. The fertility of estuaries is often greater than that of the land on the one hand, or the open sea on the other. For example, the rate of net primary production of the shallow waters and marshes lying between the mainland and the sea islands of Georgia, as measured in a series of studies at the University of Georgia Marine Institute, is estimated to be better than 10 tons of organic matter per acre per year. This is double or triple the best agricultural crop production in the state. By net primary production we mean the amount of organic matter produced by green plants which is not used by the plants themselves, and which is thereby potential food for heterotrophic organisms (animals, microorganisms and man). The potential for production of sea food for man in Georgia estuaries is thus very great, far greater than is now realized. Estimates in terms of pounds and dollars are presented in the testimony prepared by Dr. Linton of the staff of the University of Georgia Marine Institute. Yet seafood is only one of a whole spectrum of values that affect not only the people of the coastal counties but inlanders as well who come to enjoy the beaches and the beautiful watery vistas of open spaces immortalized by Sydney Lanier's poem "The Marshes of Glynn". Like any valuable natural resource estuaries deserve to be studied, their values understood and their usefulness protected against ~~senseless~~ pollution.

Estuaries belong to a class of ecological systems that can be conveniently designated as "fluctuating water-level ecosystems". The ebb and flow of water is one of the mechanisms that contributes to fertility because such back and forth circulation constantly concentrates and distributes the vital gases, -such as oxygen and carbon dioxide, and minerals, -such as nitrates and phosphates, on which productivity depends. An estuary actsessentially as a "nutrient trap" in that nutrients are held and concentrated in the estuarine zone. For example, data obtained by Dr. L. R. Pomeroy of our staff show that the average concentration of phosphorous in river waters entering the Georgia estuaries is very low (less than 0.1 micrograms per liter), so low as to limit plant growth, but in the estuary itself the concentration increases 15-fold (up to

5 micrograms per liter) to the point where plant production is no longer limited by the supply of this vital fertilizer.

Abundant nutrients and sunlight in the warm waters of Georgia estuaries are converted into three types of plant crops: (1) microscopic floating plants in the water itself, (2) microscopic plants growing on surfaces or sediments in shallow water throughout the intertidal zone and (3) marsh and sea grasses which grow in shallow water or exposed tidal sediments. These crops grow, for the most part, throughout the year. It is important to emphasize that *all three crops contribute to the total productivity*; damage or loss to any one would greatly reduce the total productivity. To the casual observer the salt marshes that are such a conspicuous part of Georgia estuaries would seem to have no direct relationship to the shrimp and fish being harvested in the sounds and off shore. Yet our work at Sapelo indicates that there is indeed a direct connection. Marsh grass is harvested by tides and converted by microorganisms into finely divided particles called "detritus" which becomes an important link along with microscopic plants in the food chains of the estuary. There is no longer any doubt that the marshes are *important "nursery grounds" for almost all species of commercial shrimp and fish*; the young stages of these species congregate and undergo their most rapid growth in the marshes and upper tidal creeks where productivity of plants and microorganisms is greatest. For example, it is well known that commercial shrimp spawn offshore and the young larval stages move into the small creeks and marshes where most of their growth takes place. On reaching adult size they then move out through the sounds and offshore water where they are harvested. If the salt marshes and the network of tidal creeks are filled in, dredged or destroyed, -or if they are made inaccessable to incoming larval stages by downstream pollution, then there is no question that a substantial protion of larval food needed would be cut off drastically reducing the seafood potential of the entire coastal zone. Physical destruction or poisoning by pollution of the inshore nursery grounds would, in our opinion, completely destroy the ~~multi-million~~ ~~dollar~~ shrimp industry.

In many basic ways estuaries operate naturally in the same manner as man's rice culture system where alternate flooding and drawdown contribute greatly to continuous fertility. The high production of oriental fish ponds is also enhanced by periodic "fallowing" of the ponds. Thus, the estuary is a natural system which operates in the same general manner as some of the most successful of man-made agricultural systems, yet it has the advantage that tidal energy rather than human labor or tax dollars does the work of circulation and fertilization. Theoretically, then, man has only to reap the harvest. Unfortunately, because of a lack of understanding of the complex nature of the estuarine system with its interdependent parts (water, sediments, marsh grass, critical tidal flow rates, nutrient traps, seafood nursery ground, etc.), and because the high natural fertility is not generally appreciated, estuaries of the Atlantic coast are in grave danger of being destroyed before their potential usefullness can be exploited.

As will be detailed elsewhere in this statement estuaries are especially vulnerable to pollution and to dredging that interfers with water circulation. Because the organic load and rate of productivity is high the oxygen demand of the system is great. This demand is normally satisfied by the combined action of strong water circulation and the activities of green plants. Many parts of an estuarine system are normally operating at full capacity in regard to oxygen; since most types of pollution, both domestic and industrial, have a high oxygen demand, a relatively small added imput can cause the system to go anaerobic (without oxygen) which means that it becomes, biologically speaking, useless. Like a race horse running at its limit of speed any added load can only reduce its performance! There are already local examples of this on the Atlantic and Gulf coasts. For example, Hillsborough Bay in Tampa Bay has become so polluted and anaerobic that noxious odors and restricted water uses plague the city of Tampa. In this case the lack of secondary sewage treatment plus wastes from phosphate mining contribute to the deplorable situation.

Pesticide pollution, a growing problem everywhere, can be especially critical in an estuary since the "nutrient trap" mechanism not only traps and concentrates useful minerals but also poisons especially the persistent materials such as DDT. Concentration of such pesticides tends to build up in the organic detritus and the plant-animal food chain by a process that has come to be known as "biological magnification". Furthermore, eggs and larva of seafood organisms are especially sensitive. Studies on Long Island recently published in the journals of "Science" and "Scientific American" have shown that sediment buildup and ecological magnification have resulted in very high and alarming DDT concentrations in tissues of fish and sea birds. A group of citizens has recently initiated legal proceeding to get their own municipal governments to stop broadcast use of DDT! The suggested solution is to use less persistent insecticides, that is, ones which degrate in water and do not build up in concentration, is mosquito and other insect control. An unexcusable type of pollution is the release of untreated wastes by pesticide manufactures. Several spectacular fish kills have recently been traced to either careless or accidental release of wastes which contain large amounts of the most toxic insecticides. While the pesticide industry perhaps has a special responsibility to the public in that they are dealing with potentially dangerous poisons in high concentration, we would not single them out as being different from other industry, since as already indicated, all industry bears a responsibility to man's environment. Quality engineering in waste treatment, as well as in the product, must become a part of the American creed of finding better ways to do things. The purpose of our testimony here is not to point fingers at anyone, or to dwell on past mistakes, but rather to emphasize that the estuarine ecosystem is a complex, productive and fragile landscape which is especially vulnerable to pollution.

In conclusion, secondary (i.e. complete) treatment for both sewage and industrial wastes is the goal that must be reached as soon as possible. Cities and industry should share equal responsibility because the economic price of pollution in terms of lost uses and expensive cleanup is almost certain to be higher than the cost of prevention. Furthermore, there is growing evidence that once an estuary has been thoroughly poisoned, it can never be fully repaired. The documented case of the Delaware Bay is an example (see "Waste Management and Control", Publ. 1400, Nat. Acad. of Sci.). Georgia is fortunate in that there is time to plan for the type of secondary waste treatment that will maintain water quality. Coastal cities and industries, because they are surrounded by so much water, are lulled into false security in thinking they don't need secondary treatment of wastes. This is definitely not so because water is shallow and not always moving in an outward direction!

The natural high fertility and usefulness of estuaries dictates that use and management should be based, as far as possible, on the concept of utilization of existing resources without changing the biological productivity and the basic flow pattern of the system. The challenge is to learn how to use and maintain the high fertility rather than to change the system radically - which can only reduce its usefulness. This, of course, is in contrast to many land areas where productivity and usefulness can often be increased by replacing natural plants with cultivated crops, or by manipulation of physical factors, such as irrigating a desert. Since the estuary is already a naturally irrigated system with adapted organisms, it is folly to destroy without reason or by neglect or poor planning this naturally engineered irrigated system just as it would be folly to destroy willfully an expensive irrigation system set up with our tax dollars! If an acre of prime Iowa farm land which produces meat by means of a corn-hog food chain is worth $400/acre, then an acre of Georgia estuary is of at least equal value because it can produce dollar value equivalent meat through a marsh grass-detritus-seafood food chain. Add to this, recreation, and open space values (which are certainly superior to that of a corn field) and the value increases. The capacity of estuaries to act as air and water purifier for wastes is a long term value which is difficult to calculate on a short term basis. The value is very great, however, when one considers the tax dollars required to correct pollution when it is allowed to get out of hand, as in the Hillsborough Bay example already mentioned. We can conclude that estuarine real estate is worth on the average at least $500/acre and is thus too valuable (1) to fill in for conventional agriculture, industrial sties or other uses for which less valuable dry land is available and (2) to use as open sewers for untreated wastes.

In Georgia a pattern of use zones, as illustrated in accompanying sketch map, has already developed which we think provides an excellent basis for future planning. Essentially there are three broad use regions.

1. Industrial zones, as for example, the Savannah River estuary, which are subjected to extensive modification and where pollution control and maintenance of water quality ~~studies~~ are of paramount concern.

2. *Natural use zones* where the basic pattern of landscape remains undisturbed and where recreation, fishing, seafood production, etc. are the primary purposes. To maintain such use it is necessary that large areas of shallow water and marsh be acquired by local, state, federal agencies or by private foundations so that restrictions in the public interest can be effective. *It should be emphasized that "natural use planning" in this case* is intended to provide full utilization in its natural state and is in no way intended to restrict human use of economic return so long as such uses do not destroy the natural beauty and reduce productivity as it already exists. Within a large natural use area a gradient of use intensity is desirable ranging from wilderness areas to heavy use seashore parks. We believe that large sections of Georgia coast should remain in the natural use category.

3. *Research zones*. - The Sapelo-Blackbeard island region comprises a unique research area maintained by foundation and federal support. It is particularly important that large areas of typical estuary be available for, and restricted, to research use. Not only are there many basic studies that must be done, but also feasibility studies on oyster farming, effects of waste material, and the like, can only be carried out on a reasonable large scale. We would recommend for the whole Atlantic and Gulf coast that *estuarine research parks* be established (or developed from expansion of existing marine laboratories) *at intervals of 100-200 miles.* *Research laboratories are not in themselves adequate; there must be large areas of the environment itself under research control equivelent, for example, to* large terrestrial watersheds. Since details of conditions vary from place to place, we believe a network of research areas would be the greatest investment we can make in maintaining the quality of our waters and estuaries.

Further details are included in the following published or mimeographed documents which are submitted as part of this testimony:

Odum, Eugene P. The role of tidal marshes in estuarine production. Published first in "New York State Conservationist", 1961, New York State Conservation Department, issued as an information leaflet, and reprinted in the Proceeding of the MAR Conference 1962, IUCN Publications.

Schelske, Claire L. and Eugene P. Odum. 1961. Mechanisms maintaining high productivity in Georgia Estuaries. Proc. Gulf and Caribbean Fisheries Institute, 14th annual session, pages 75-80.

Odum, Eugene P. The urgent need for landscape zoning of the estuarine region according to ecosystem principles. Address presented at a Symposium on Estuarine Ecology of Coastal Waters of North Carolina. Raleigh, North Carolina, May 12, 1966. Published in proceeding of that conference by Water Resources Institute of the University of North Carolina.

Odum, Eugene P. 1967. Natural production in estuaries, a source of food for oysters. Opening remarks, Oyster Culture Workshop, Sapelo Island Georgia. Mimeographed.

Odum, Eugene P. and Armando A. de la Cruz. 1967. Particulate Organic Detritus in a Georgia Salt Marsh Estuarine Ecosystem. In: ESTUARIES (George Lauff, Editor), Amer. Assoc. Adv. Sci.

Odum, Eugene P. 1967. Man and the landscape. Review of"Waste Management and Control". Scientist and Citizen, January 1967. St. Louis Citizens Committee for Information.

STATEMENT OF JOHN F. MCGOWAN ON BEHALF OF OCEAN SCIENCE CENTER OF THE ATLANTIC COMMISSION. SKIDAWAY ISLAND, SAVANNAH, GEORGIA, AND THE SAVANNAH RIVER BASIN DEVELOPMENT COMMISSION, 507 AMERICAN BUILDING, SAVANNAH, GEORGIA

In American life today there is a bloodless conflict, possibly more acute because the motivations are sincere.

The rapid habitation of lands heretofore accepted as the domain of marine life begins to assume critical proportions.

Silting, current displacements, land fills, and other forms of pollution disturb ecological balance and disrupt the propagative process.

This is notably true in the instance of our marsh lands. In the past, we have been largely unconscious of their value.

We have looked upon these vast and waving savannas not realizing that they are the breeding place of our fish and shrimp.

As Nancy Butler, a naturalist in THE ISLANDER, has so eloquently written:

> "No one hears their death cries as their graves are measured and dug by the cubic yard. In the remaining vacuum, few will detect the absence of so many tiny lives--snails, mud worms, phytoplankton and algae, killifish, silversides, anchovies and mullet. Suddenly, however, the bass, bluefish and flounder, the terns, herons, grebes, loons and mergansers, the crabs and terrapins, and, ultimately the mammals will be seen to disappear, if the bottom of the food chain is destroyed along our shoreline. All these tiny lives depend on the salt marsh for survival."

The conservation of estuarine and deep water life, so that harvest can be obtained and yet life and a propagation balance maintained, is a pre-eminent objective of the ocean sciences.

A careful and continued study of the problems relating to this adjustment is indicated. These studies in one form or another are going on all over the world. In this Country they should be emphasized and more trained people applied to the task.

It is a question of the reconciliation on the environments.

The man environment must seek an accommodation with the estuarine-ocean environment.

There is a place for both, with man still coming out the beneficiary of the gifts of food and health to be supplied by the sea. The bottom of the food chain and the successive linkages supporting marine life must be understood, and, therefore, conserved within the context of man's increasing numbers and demands.

We believe that this is a matter which strongly addresses itself to State interest, and the activities of the State of Georgia in this area are a matter of record. Its estuarine studies at its Marine Institute at Sapelo Island, and its Ocean Science Center of the Atlantic at Skidaway Island are major-scale activities which indicate the State's concern in this field and its resolution to act. The Savannah River Basin Development Commission, a bi-State activity representing the economic and civic interest of approximately one million citizens in the Basin area, applauds the leadership of the State of Georgia in this field.

AIG

181 Washington St., S.W.
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STATEMENT BY
ASSOCIATED INDUSTRIES OF GEORGIA

AT A PUBLIC MEETING ON THE ESTUARINE WATERS OF GEORGIA
JEKYLL ISLAND, GEORGIA

FEBRUARY 29, 1968

My name is Glenn Kimble. I appear here in behalf of the Associated Industries of Georgia. I am a member of the Board of Directors of the Association and also Chairman of the Air and Water Resources Committee.

My purpose is to reaffirm the position of this organization of Georgia business and industry with regard to the management and protection of the waters of Georgia.

As many of you are aware, the Associated Industries of Georgia has initiated many efforts and has actively supported the efforts of others to improve the protection of our air and water resources. It is our intent to continue to pursue this course.

Concerning the matter under discussion today, the estuarine waters of this region, we urge caution and the fullest consideration of all the components of this region's socio-economy, both present and potential.

There is probably no single hydrographic system which equals either the complexity or the importance of the estuarine waters of the east coast of America.

It is clear that the present condition of these waters demands responsible attention. I emphasize the word responsible. We feel that no drastic steps should be taken without considering all of the effects.

By this, we do not mean to convey that nothing should be done. We believe that there should be efforts to improve existing conditions and to plan for the future.

However, we believe that something is being done, that great effort is being expended fruitfully.

Industries and municipalities alike are spending millions of dollars to construct treatment facilities for their wastes. There is research being done by the University of Georgia at Sapelo Island. The state sponsored Ocean Science Center being built at Skidaway Island promises to provide even more intensive research. Georgia has provided a sound and practical program which will protect the estuaries and the other waters of this state for the greatest good of the greatest number of Georgians.

Surely all of the job is not yet done; nor will it ever be complete. If Georgia and the nation continue to grow in numbers of people and in economy, and we believe that they will, there will be a continuing and intensifying need for research to find better ways for the control of pollution and for its prevention. We recommend that the efforts of any new agencies or funds be directed to these ends. We strongly urge that the administration and enforcement of pollution control efforts in the estuarine waters of Georgia be left in the capable and competent hands of the Georgia Water Quality Control Board.

Greater Atlanta Chapter
IZAAK WALTON LEAGUE OF AMERICA

March 4, 1968

Mr. Jim Silva
Federal Water Pollution Control Administration
Southeastern Water Laboratory
Athens, Georgia

Dear Mr. Silva:

I am sorry that I couldn't be present for the Estuarine Pollution hearing at Jekyll Island.

Our Chapter of the Izaak Walton League of America stands four square against all forms of water pollution. We are aware that pollution cannot be stopped overnight, but at the same time, we take the position that the only way to bring any of these problems to a proper conclusion is to make a beginning.

We know that a proper and meaningful study must be made before we can start solving any of these pollution problems, but we feel that a basic action of some kind should begin promptly, in a matter of a few months as opposed to a year or so.

There is absolutely no reason why all pollution cannot be stopped within five years. Of course, the cost would be high in some cases.

Those industries that are presently dumping pollutants into our streams should be given a specified length of time to present a program which climaxes in a clean effluence. Any new industries should have a built-in process to solve their problems before they are given operating permits. Federal money could be loaned to operating offenders.

Municipalities should be required by law to solve their problems within a reasonable time. The Federal Government might have to continue giving extensive aid in this phase of the program.

The manufacture of safe pesticides should be demanded and a compliance date set.

As you can see, our group takes a hard let-the-chips-fall-where-they-may line on this very important matter.

Let us serve you to this end in any way possible.

Sincerely,

5585 Whitner Dr. N.W.
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James F. Cheves Jr., President

NEPS Public Meeting
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